NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

K.R.NAGAR, KOVILPATTI

www.nec.edu.in

REGULATIONS – 2023

CURRICULUM & SYLLABUS

B. TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(Outcome Based Education & Choice Based Credit System)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

VISION

To produce globally competent, innovative, computing professionals to meet current challenges in the field of Artificial intelligence and Data Science with social responsibilities

MISSION

1. Offering well-balanced curriculum with state of the art technologies to impart professional competencies and transferable skills.
2. Bringing innovations in Teaching-Learning process through experienced learning and project / product based learning.
3. Collaborating National and International Industries and Academia to develop foresight technologies in Artificial intelligence and Data Science.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Within few years (3 to 5 years) of graduation, our graduates are expected:

1. tobe successful in their professional career as data scientist, data modeler, data architect, business intelligence developer and software developer with technical and managerial skills in the field of artificial intelligence and data science
2. topursue higher studies at the institute of repute in India and abroad and work in educational institutions, research organizations and reputed software industries and be successful entrepreneurs.
3. To collaborate in multi-disciplinary teams and be the leaders in their organizations, their profession and in society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Design and develop AI tools for automated intelligent systems and deliver robust product.
2. Design and analyze domain specific big data systems using predictive analytics.

PROGRAMME OUTCOMES (POs)

By the time of graduation graduates will attain the following programme outcomes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

REGULATIONS 2023
CURRICULUM AND SYLLABUS

SEMESTER – I

S No	Course Code	Course title	Category	Periods Per week				Total No.of Hours	Credits
				L	T	P	E		
*** Induction Program-2 weeks**									
Theory Courses									
1	23SH11C	தமிழர்மரபு/Heritage of Tamils	HSMC	1	0	0	0	1	**1**
2	23SH12C	Mathematical Foundations for Engineers	BSC	3	1	0	0	4	**4**
3	23SH13C	Introduction to Engineering	ESC	1	0	0	0	1	**1**
Integrated Courses									
3	23SH14C	Technical English	HSMC	1	0	2	0	3	**2**
4	23SH15C	Engineering Physics	BSC	2	0	2	0	4	**3**
5	23SH16C	Engineering Chemistry	BSC	2	0	2	0	4	**3**
6	23CS11C	Problem Solving Techniques	ESC	3	0	2	0	5	**4**
7	23ME11C	Engineering Graphics	ESC	2	0	4	0	6	**4**
			TOTAL	**15**	**1**	**12**	**0**	**28**	**22**

SEMESTER – II

S No	Course Code	Course title	Category	Periods Per week				Total No. of Hours	Credits
				L	T	P	E		
Theory Courses									
1	23SH21C	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HSMC	1	0	0	0	1	**1**
2	23GN01C	Aptitude Essentials	EEC	1	0	0	0	1	**1**
3	23GN05C	Professional Ethics and Human Values	HSMC	2	0	0	0	2	**2**
4	23AD21C	Computer Organization and Architecture	ESC	3	0	0	0	3	**3**
5	23AD23C	Probability and Statistics	BSC	3	1	0	0	4	**4**
Integrated Courses									
6	23AD22C	Semiconductor Physics and Digital Electronics	ESC	2	0	2	0	4	3
7	23SH22C	Professional English	HSMC	2	0	2	0	3	**2**
8	23EE11C	Basic Electrical and Electronics Engineering	ESC	3	0	2	0	5	**4**
9	23AD24C	Python Programming	PCC	3	0	2	0	5	**4**
Practical Course									
10	23GN02C	Innovation through Design Thinking	EEC	0	0	0	4	2	**2**
			TOTAL	**20**	**1**	**8**	**4**	**32**	**26**

SEMESTER – III

S No	Course Code	Course title	Category	Periods Per week				Total No. of Hours	Credits
				L	T	P	E		
Theory Courses									
1	23AD31C	Operating Systems	PCC	2	1	0	0	3	**3**
2	23AD32C	Data Warehousing and Data Mining	PCC	3	0	0	0	3	**3**
3	23MC02C	Environmental Science and Engineering	MAC	2	0	0	0	2	**0**
4	23AD33C	Linear Algebra	BSC	3	1	0	0	4	**4**
Integrated Courses									
5	23AD34C	Object Oriented Programming with Java	PCC	3	0	2	0	5	**4**
6	23AD35C	Data Structures	PCC	3	0	2	0	5	**4**
7	23AD36C	Artificial Intelligence	PCC	3	0	2	0	5	**4**
Practical Courses									
8	23AD37C	Linux System Administration	PCC	0	0	2	0	2	**1**
9	23GN03C	Intellectual Property Rights study	EEC	0	0	2	2	4	**2**
			TOTAL	**19**	**2**	**10**	**2**	**33**	**25**

SEMESTER – IV

S No	Course Code	Course Title	Category	Periods Per week				Total No. of Hours	Credits
				L	T	P	E		
Theory Courses									
1	23AD41C	Design and Analysis of Algorithms	PCC	3	0	0	0	3	**3**
2	23AD42C	Data Exploration and Visualization	PCC	3	0	0	0	3	**3**
3	23AD43C	Computer Networks	PCC	3	0	0	0	3	**3**
4	-	Elective Course - (Science stream)	BSC	3	0	0	0	3	**3**
Integrated Courses									
5	23AD44C	Machine Learning	PCC	3	0	2	0	5	**4**
6	23AD45C	Database management Systems	PCC	3	0	2	0	5	**4**
7	23AD46C	Fundamentals of Data Science and Analytics	PCC	2	0	2	2	6	**4**
Practical Courses									
8	23AD47C	Modeling Projects	EEC	0	0	2	2	4	**2**
9	23GN04C	Aptitude Excellence	EEC	0	0	2	0	2	**1**
			TOTAL	**20**	**0**	**10**	**4**	**34**	**27**

SEMESTER – V

S No	Course Code	Course title	Category	Periods Per week				Total No. of Hours	Credits
				L	T	P	E		
Theory Courses									
1	23AD51C	Devops and Agile methodologies	PCC	2	0	0	0	2	**2**
2	-	Program Elective Course I	PEC	3	0	0	0	3	**3**
3	-	Program Elective Course II	PEC	3	0	0	0	3	**3**
4	23AD52C	Natural Language Processing	PCC	3	0	0	0	3	**3**
5	23MC01C	Constitution of India	MAC	2	0	0	0	2	**0**
Integrated Courses									
6	23AD53C	Big Data Analytics	PCC	3	0	2	0	5	**4**
7	23AD54C	Embedded Programming	ESC	2	0	2	0	4	**3**
8	23AD55C	Deep Learning	PCC	2	0	2	2	6	**4**
Practical Course									
9	23AD56C	Simulation using Modern tool	EEC	0	0	2	2	4	**2**
			TOTAL	**20**	**0**	**8**	**4**	**32**	**24**

SEMESTER – VI

S No	Course Code	Course title	Category	Periods Per week				Total No. of Hours	Credits
				L	T	P	E		
Theory Courses									
1	23GN06C	Project Management and Finance	HSMC	2	0	0	0	2	**2**
2	-	Open Elective Course I	OEC	3	0	0	0	3	**3**
3	-	Open Elective Course II	OEC	3	0	0	0	3	**3**
4	23AD61C	Optimization Techniques	PCC	3	0	0	0	3	**3**
5	-	Program Elective Course III	PEC	3	0	0	0	3	**3**
Integrated Courses									
6	-	Program Elective Course IV	PEC	3	0	2	0	5	**4**
7	23AD62C	Computer Vision	PCC	2	0	2	0	4	**3**
Practical Course									
8	23AD63C	Product Development Practice	EEC	0	0	0	4	4	**2**
			TOTAL	**19**	**0**	**4**	**4**	**27**	**23**

SEMESTER – VII

S No	Course Code	Course Title	Category	Periods Per week				Total No. of Hours	Credits
				L	T	P	E		
Theory Courses									
1	-	Open Elective Course III	OEC	3	0	0	0	3	**3**
2	-	Program Elective Course V	PEC	3	0	0	0	3	**3**
3	-	Program Elective Course VI	PEC	3	0	0	0	3	**3**
Practical Course									
4	23AD71C	Mini Project	EEC	0	0	0	6	6	**3**
5	23AD72C	Inplant training/Internship	EEC	-	-	-	-	-	**2**
			TOTAL	**9**	**0**	**0**	**6**	**15**	**14**

SEMESTER – VIII

S. No	Course Code	Course Title	Category	Periods Per Week				Total No. of Hours	Credits
				L	T	P	E		
Practical Courses									
1.	23AD81C	Capstone Project / Industry Practice	EEC	0	0	0	12	12	6
			TOTAL	**0**	**0**	**0**	**12**	**12**	**6**

TOTAL CREDITS: 167

CURRICULUM STRUCTURE

Category	I	II	III	IV	V	VI	VII	VIII	Credits	Percentage of credits
HSMC	3	5				2			10	6%
BSC	10	4	4	3					21	12.57%
ESC	9	10			3				22	13.17%
PCC		4	19	21	13	6			63	37.72%
PEC					6	7	6		19	11.37%
OEC						6	3		9	5.38%
EEC		3	2	3	2	2	5	6	23	13.77%
Total	22	26	25	27	24	23	14	6	167	

ELECTIVE COURSES (SCIENCE STREAM)

S. No	Course Category	Course Code	Course Name	L	T	P	E	C
MATHEMATICS								
1.	OEC	23SH01E	Linear Algebra, Mathematical Logic and Set Theory	2	1	0	0	3
2.	OEC	23SH02E	Linear Structures and Transformations	2	1	0	0	3
3.	OEC	23SH03E	Number Theory	2	1	0	0	3
4.	OEC	23SH04E	Numerical Analysis	2	1	0	0	3
5.	OEC	23SH05E	Optimization Techniques	2	1	0	0	3
6.	OEC	23SH06E	Principles of Discrete Mathematics	2	1	0	0	3
7.	OEC	23SH07E	Random Processes and Queuing Theory	2	1	0	0	3
8.	OEC	23SH08E	Statistical Techniques and Numerical Methods	2	1	0	0	3
9.	OEC	23SH09E	Transforms, Mathematical Logic and Set Theory	2	1	0	0	3
PHYSICS								
10.	OEC	23SH10E	Fundamentals of Laser Technology	3	0	0	0	3
11.	OEC	23SH11E	Nanomaterials for Engineers	3	0	0	0	3
12.	OEC	23SH12E	Photonics	3	0	0	0	3
CHEMISTRY								
13.	OEC	23SH13E	Biology for Computing	3	0	0	0	3
14.	OEC	23SH14E	Biological systems for Engineers	3	0	0	0	3
15.	OEC	23SH15E	Polymer Science and Technology	3	0	0	0	3
16.	OEC	23SH16E	Sensors for Engineering Applications	3	0	0	0	3

Course Code	**தமிழர் மரபு (HERITAGE OF TAMILS)**	**L**	**T**	**P**	**E**	**C**
23SH11C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

இப்பாடம் முடிந்ததும் மாணவர்களிடம் வளரும் திறன்

CO1: தமிழ் மொழியின் இலக்கிய வளம், ஓவிய, சிற்பக் கலையின் பரிணாம வளர்ச்சி நாட்டுப்புறக் கலை மற்றும் வீர விளையாட்டுக்கள் பற்றிய அறிவு மற்றும் விளக்கும் திறன்

CO2: தமிழர்களின் திணை சார் கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டில் தமிழர்களின் பங்கு பற்றிய அறிவு மற்றும் விளக்கும் திறன்

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: know and explain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

CO2: know and explain about Tamils Thinai concepts, contribution of Tamils in Indian National Movements and Indian Culture

CO1: தமிழ் மொழியின் இலக்கிய வளம், ஓவிய, சிற்பக் கலையின் பரிணாம வளர்ச்சி நாட்டுப்புறக்கலை மற்றும் வீர விளையாட்டுக்கள் பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:9**

இந்திய மொழிக்குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு - நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு - தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

CO1: know and explain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan - Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils - Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

CO2:தமிழர்களின் திணை சார் கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டில் தமிழர்களின் பங்கு பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:6**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி - இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

CO2: know and explain about Tamils Thinai concepts, contribution of Tamils in Indian National Movements and Indian Culture

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas - Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

L: 15; TOTAL: 15 PERIODS

Course Code	MATHEMATICAL FOUNDATIONS FOR ENGINEERS	L	T	P	E	C
23SH12C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: interpretthe nature of quadratic form by orthogonal transformation.
CO2: identify the maxima and minima of functions.
CO3: solve ordinary differential equations.
CO4: find the solution of partial differential equations.
CO5: evaluate integrals of multivariate calculus.

Soft skill Component

CO6 : develop communication, problem solving and interpersonal skills

CO1: interpret the nature of quadratic form by orthogonal transformation. **L:9,**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors – Diagonalisation of a matrix by orthogonal transformation – Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature; Cayley – Hamilton theorem (excluding proof) -Application: Stretching of a elastic membrane. **T:3**

CO2: identify the maxima and minima of functions. **L:9,**

Functions of two variables: Limit, continuity and partial derivatives; Total derivative, Jacobian, Taylor series- Application :Linearization of Non Linear systems using Taylor Series - Maxima and minima - Method of Lagrange multipliers. **T:3**

CO3: solve ordinary differential equations. **L:9,**

Solutions of first order ordinary differential equations - Equations solvable for ‘p’, equations solvable for ‘y’, equations solvable for ‘x’ - Solutions of higher order linear differential equations with constant coefficients – Cauchy’s and Legendre’s linear equations - Method of variation of parameters – Solution of simultaneous linear differential equation. Application RCL – circuit and Mass Spring System. **T:3**

CO4: find the solution of partial differential equations. **L:9,**

Formation of partial differential equations – Solutions of standard types of first order partial differential equations - Lagrange’s linear equations - Solutions of homogeneous and Non homogeneous linear partial differential equations of second and higher order with constant coefficient – Application - Shallow wave equations of first order PDE. **T:3**

CO5 : evaluate integrals of multivariate calculus **L:9,**

Double integration – Cartesian and polar coordinates - Change of order of integration - Change of variables - Cartesian to polar coordinates - Area as double integral - Triple integration - Cartesian and polar coordinates – Change of Variables- Cartesian to spherical and cylindrical coordinates. Application – Moments and centers of mass. **T:3**

TEXT BOOKS:

1. Grewal.B.S., Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2021.
2. James E. Gentle, Matrix Algebra, Springer International Publishing, 2nd Edition, 2017
3. ShankerRao.G., Linear Albebra, WileyIndia, 1st Edition , 2017

REFERENCES:

1. Bali.N.P. and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications Private Limited, 10th Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 10th Edition, 2017.
3. Kenneth B. Howell, Ordinary Differential Equations, CRC Press, 2020.
4. James Strewart, Daniel Clegg, Saleem Watson, Essential Calculus Early Trancendentals, Cengage Learning, 9th Edition, 2021.
5. Nanda Kumar A.K, P.S.Datti: Raju .K.George , Ordinary Differential Equations, Cambridge University press, 2017.

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	INTRODUCTION TO ENGINEERING	L	T	P	E	C
23SH13C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: articulate the importance of Engineering and its role in society through OBE framework
CO2: identify and describe academic pathways towards career settlement

CO1: articulate the importance of Engineering and its role in society through OBE framework **L:9**

Engineering – An introduction, Classification of different Engineering Disciplines, Role of Engineers in Society. Graduate Attributes (GA), Program Specific Criteria (PSC)- Program Educational Objectives (PEO), Program Outcomes (PO), Course Outcomes (CO), Choice Based Credit System (CBCS), course categories, teaching and learning process, active and passive learning, project / problem based learning, different assessments process.

CO2: identify and describe academic pathways towards career settlement **L:6**

Curriculum, cafeteria curriculum and self-learning big picture of the Program and the significance of each course in the undergraduate Engineering Program, Discuss the different career paths for an engineering graduate. Career objective, competency requirement.

Case study: Each student has to interact with alumni mentors/seniors/faculty members/surf the internet and present a career path that inspires him/her at the end of the course

REFERENCES:

1. Quamrul H. MazumderIntroduction to Engineering, An Assessment and Problem Solving Approach, CRC Press, 1st Edition, 2016.
2. SaeedMoaveni, "Engineering Fundamentals an Introduction to Engineering", Cengage Learning, USA, 4th Edition, 2011.

L: 15; TOTAL: 15 PERIODS

Course Code	TECHNICAL ENGLISH	L	T	P	E	C
23SH14C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**1**	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply the fundamental grammar rules in writing

CO2: utilizing phonetic transcription for pronunciation

Practical Component

CO3: apply the basic language skills in various aspects of communication

CO4: utilize technical terms and phrases in specific contexts

CO5: develop the pronunciation skill through various language components

CO6: distinguish different writing forms and interpret text through divergent thinking

CO7: develop effective reports with grammatical and language components

Soft skill Component

CO8: develop communication, team spirit, creativity and time management

CO1: apply the fundamental grammar rules in writing **L:13, P:26**

Parts of Speech - Word Formation using Prefix and Suffix - Sentence formation (Kinds of Sentences) - Tenses (Present, Past & Future tense) – Concord

CO3: apply the basic language skills in various aspects of communication

Diary Writing - Greeting and Self Introduction

CO4: utilize technical terms and phrases in specific contexts

Technical terms and extended definition - Essay Writing (Argumentative Essay and Analytical Essay) - Situational phrases & Conversation - Formal Letter Writing (Permission & Requisition letters)

CO6: distinguish different writing forms and interpret text through divergent thinking

Picture Description, Introduction to Reading Techniques (Skimming, scanning, inferring, predicting, Reading and Reviewing a book (Sci – Fi), E Mail Writing

CO7: develop effective reports with grammatical and language components

Listening and responding to general information (Business context) - Report Writing (Types, Structure, and Stages of report writing) - Checklist

CO2:utilizing phonetic transcription for pronunciation **L:2, P:4**

Phonetics (Vowels & Consonants)

CO5: develop the pronunciation skill through various language components

Word Transformation from one form to another - Letter Writing (Informal) - Listening and responding to general information (General context)

TEXT BOOKS:

1. Paul V. Anderson, Technical Communication: A Reader - Centered Approach, Cengage Learning, 9th Edition, 2017.
2. Ravindra NathTiwari, Technical English-II, Shashwat Publication, 1st Edition, 2020.
3. Stephen D. Krashen, Principles and Practice in Second Language Acquisition. Pergamon, 1987.
4. Lester Kaufman and Jane Straus, The Blue Book of Grammar and Punctuation: An Easy-to Use Guide with Clear Rules, Real-World Examples, and Reproducible Quizzes, Wiley, 2021.
5. Wells H. G., The Time Machine, Penguin Classics, 2012.

REFERENCES:

1. Michael McCarthy, English Grammar: The Basics, Taylor & Francis, 2021.
2. Peter Lucantoni and Lydia Kellas, Cambridge IGCSE(TM) English as a Second Language Workbook, Cambridge University Press, 6th Edition, 2022.

L: 15; P: 30; TOTAL: 45 PERIODS

Course Code	ENGINEERING PHYSICS	L	T	P	E	C
23SH15C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to:

Theory Components:

CO1: identify the structural properties of crystalline materials
CO2: comprehend and apply the concepts of centre of mass and elasticity
CO3: explain thermodynamic parameters and fundamental laws and their application in various processes
CO4: illustrate the applications of different lasers and optical fibers
CO5:interpret the quantum concepts, to illustrate the quantization of energy, and computation

Practical Components:

CO6: compare the mechanical properties of the materials due to bending and torsion
CO7: analyze thermal conductivity of different bad conducting materials
CO8: explore the light-matter interaction by the phenomenon of interference and diffraction and photoelectric effect

Soft skill Component:

CO9: develop the team spirit and communication skill through group activities

CO1: identify the structural properties of crystalline materials **L:10**

Crystalline and amorphous materials - unit cell - primitive cell - crystal systems, Bravais lattices - Miller indices – interplanar distance – Characteristics of SC, BCC, FCC, HCP structures - Bragg's law - X-ray diffraction and its applications - Synthesis of crystalline materials

CO2: comprehend and apply the concepts of centre of mass and elasticity **L:6,**
CO6: compare the mechanical properties of the materials due to bending and torsion **P:10**

Multi-particle dynamics - Introduction - Center of mass (CM) – CM of continuous bodies - Introduction to rigid bodies - translation - rotation – moment of inertia – theorems of moment of inertia – Torsional pendulum.

Elasticity – Stress - strain diagram and its applications - Moduli of elasticity and its relation - bending of beams - Bending moment – cantilever - theory and experiment - Uniform bending - theory and experiment – Non Uniform bending - I-shaped girders

CO3: explain thermodynamic parameters and fundamental laws and their application in various processes **L:6, P:8**

CO7: analyse thermal conductivity of different bad conducting materials.

Laws of thermodynamics – Thermo dynamical processes – Introduction to heat transfer – conduction - convection and radiation – thermal conductivity of good conductor –Radial flow of heat - Spherical shell method and cylindrical shell method – Thermal conductivity of poor conductor- Lee's disc method– Applications - heat exchangers - refrigerators and ovens

CO4: illustrate the applications of different lasers and optical fibers **L:6, P:6**

CO8: explore the light-matter interaction by the phenomenon of Interference and diffraction and photoelectric effect

Lasers: Interaction of light with matter - Einstein coefficients and their relations – characteristics of laser - components of laser – Lasing action – Pumping methods – Types of Laser - Nd-YAG laser -semiconductor laser- Applications

Fiber optics: principle and classification of optical fibers – propagation of light in optical fiber - Numerical aperture and Acceptance angle – losses associated with optical fibers (Qualitative) – Fiber optic communication system - Applications - Displacement and pressure sensors – Endoscopy

CO5: interpret the quantum concepts, to illustrate the quantization of energy, and computation **L:6, P:2**

CO8: explore the light-matter interaction by the phenomenon of interference and diffraction and photoelectric effect

Planck's radiation law - de-Broglie hypothesis – Matter waves - Heisenberg's uncertainty principle – elementary proof – applications – Schrödinger's time-dependent and time-independent wave equation – physical significance of wave function – Introduction to quantum tunneling - applications - particle in a one-dimensional box – tunneling microscope – quantum confinement in 0D, 1D, 2D systems - quantum computation

TEXT BOOKS:

1. AvadhanuluM. N., Kshirsagar P.G and Arun Murthy T.V.S, A Text book of Engineering Physics, S.Chand & Co, 11th Edition, 2018.
2. Kleppner D and Kolenkow R. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
3. Kenneth S Krane, Modern Physics, Wiley, 4th Edition, 2021.

REFERENCES:

1. Wolfson R., Essential University Physics, Volume 1 & 2, Pearson Education, 2nd Indian Edition, 2009.
2. Hitendra K. Malik, A.K.Singh, Engineering Physics, McGraw Hill Education, 2nd Edition, 2017.
3. Kyungwon An, Fundamentals of Laser Physics, World Scientific Publishing Company, 2023
4. Halliday D, Resnick R and Walker J, Principles of Physics, Wiley, 12th Edition, 2021.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ENGINEERING CHEMISTRY	L	T	P	E	C
23SH16C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: explain the suitable water treatment technologies for domestic and industrial applications

CO2: apply the knowledge of corrosion to solve the industrial problems

CO3: describe the preparation, properties and their applications of smart materials in various sectors

CO4: describe the basic components and performance analysis of batteries

CO5: predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

Practical Component

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Soft skill Component

CO8: develop interpersonal, work ethics and communications skills for career settlement

CO1: explain the suitable water treatment technologies for domestic and industrial applications

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

Introduction, sources and impurities in water, potable water specifications (as per WHO and BIS) - hardness-types-estimation of $Ca^{2+}$and Mg^{2+} ion in water by EDTA method. Alkalinity-types-determination of alkalinity of water -chronic daily intake - incremental life time risk - hazard quotient, hazard index, contamination factor - determination of chloride ion in water using Argentometric method-municipal water treatment- physical methods and chemical methods. Disinfection-internal conditioning - calgon and carbonate conditioning. Desalination-types-Reverse Osmosis (RO) process- Forward osmosis (FO) - electro dialysis - demineralization. **L:6, P:12**

CO2: apply the knowledge of corrosion to solve the industrial problems.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Corrosion – mechanism of dry and wet corrosion-forms of corrosion– galvanic corrosion and differential aeration corrosion, crevice corrosion, pitting corrosion, microbial corrosion-stress corrosion, intergranular corrosion - determination of rate of corrosion by weight loss method. **L:6, P:6**

Protection: cathodic protection, surface coatings, corrosion inhibitors. Corrosion of industrial components: corrosion and its control in power industries, automotive industries, chemical processing industries and marine industries.

CO3: describe the preparation,properties and their applications of smart materials in various sectors

L:6

Polymers: introduction - classification - functional polymers: electroluminescence polymer, biodegradable polymers, fire retardant polymer, thermo responsive polymer -

piezo, ferro and pyroelectric polymer - nanocomposites: introduction, synthesis, properties & applications- synthesis of nanocomposites using sol -gel process

CO4: describe the basic components and performance analysis of batteries

Introduction - components - operation principle - Lead acid – Nickel metal hydride batteries- Lithium ions batteries: Lithium polymer battery, Lithium sulphur battery - fabrication and performance evaluation- safety issues - battery management system - recycling of lithium batteries. **L:6**

CO5:predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques.

Spectroscopy methods: Beer-Lambert's law and its limitations– UV-visible spectroscopy and IR spectroscopy – principle - instrumentation– applications. Estimation of copper. Electro analytical methods: potentiometric titration - Estimation of Fe^{2+} ion by potentiotometric method. Conductometric method- estimation of HCl by conductometric titration- pH metric method-Estimation of HCl by pH metric titration- applications. Thermal analytical methods: Thermal Gravimetric Analysis (TGA) and Differential Thermal Analysis (DTA)- Thermo Mechanical Analysis (TMA) –principle - instrumentation - Thermo gravimetric analysis of $CuSO_4.5H_2O$- applications. **L:6, P:12**

TEXT BOOKS:

1. Jain P.C. and Jain M, Engineering Chemistry, DhanpatRai Publishing Company, New Delhi, 17th Edition, 2021.
2. Dara S.S and Umare S.S, A Text Book of Engineering Chemistry, S.Chand & Company Limited, 20th Edition, 2018.
3. Agarwal S, Engineering Chemistry, Cambridge Publishing Company, 2nd Edition, 2019

REFERENCES:

1. Benjamin M. M, Water Chemistry, Waveland Press, 2nd Edition, 2019.
2. Cicek V, Corrosion Engineering, Springer Publishing, 1st Edition, 2021.
3. Shahinpoor. M, Fundamentals of Smart Materials, Publisher: Royal Society of Chemistry, 1st Edition, 2020.
4. Berg H, Bernhardsson S, and Johansson P, Electric Vehicle Batteries: Moving from Research towards Innovation, Publisher: Springer, 1st Edition, 2019.
5. Crouch S, Skoog D, Holler F, Principles of Instrumental Analysis, 2017.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	PROBLEM SOLVING TECHNIQUES	L	T	P	E	C
23CS11C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**3**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theroy Component

CO1:apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems

CO2:apply fundamental, sequential, conditional logic statements and arrays for solving basic problems

CO3: implement modular programming concept using user defined functions

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions

CO5: develop file processing application programs

Practical Component

CO6: develop programs for simple algorithms using sequential and Control structures

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

CO8: develop application programs using structures and files concept.

CO1: apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems **L:6**

Overview of programming: Problem Solving in Everyday Life, Types of Problem, Computer-based problem solving, Algorithms - Building blocks of algorithms (statements, control flow, functions) - Notation (pseudo code, flow chart) – Problem solving aspect – Top down design – Implementation of algorithms – Program Verification – Efficiency of algorithms – Analysis of algorithm.

CO2: apply fundamental, sequential, conditional logic statements and arrays for solving basic problems

Data Types - Constants – Variables - Keywords – Operators– Problem Solving using fundamental algorithms. Control Statements: Branching and Looping - Algorithms Using Selection and Repetition - Summation of a set of numbers, Reversing Digits of an Integer - Implementation of fundamental algorithms and factoring methods - Array Techniques - Array order reversal, Array Counting, Finding maximum and the minimum value in a set **L:12, P:10**

CO6: develop programs for simple algorithms using sequential and Control structures

Solve problems using control statements (Decision making and Looping)

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Problem solving based on Array Handling(1D and 2D, Multi-dimensional arrays, traversal, rotation) - Solve problems to handle strings

CO3: implement modular programming concept using user defined functions **L:10, P:8**

Modular Programming approach: Modularization and recursion - Bubble Sort, Selection Sort, Linear Search, Binary Search, Implementation of sorting and searching

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Solve problems by using modular approach (Functions and Recursion)

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions **L:12, P:10**

Pointer Concept – add numbers using call by reference – finding maximum number from list of numbers - permutations of a given string using pointers – Implementation of function returns a pointer;

Structures & Union - finding the largest element of an array using Dynamic Memory

Allocation – Implementation of Student database in structure using Dynamic Memory Allocation;

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Build efficient solutions to manage memory efficiently through Pointers.

CO8: develop application programs using structures and files concept.

Develop applications using Structures

CO5: Develop file processing application programs **L:5, P:2**

File Handling: Files - Introduction, Types of file processing: Sequential access, Random access – Implementation of word count, copy file, Voter's age validation, Marks range validation

CO8: Develop application programs using structures and files concept.

Develop applications using Files

TEXT BOOKS:

1. Maureen Sprankle and Jim Hubbard, Problem Solving and Programming Concepts, Prentice Hall, 9th Edition, 2012.
2. R.G Dromey, How to solve it by Compute, Pearson education, Delhi, 2nd Edition, 2021.

REFERENCES:

1. Behrouz A. Forouzan, Richard F.Gilberg, P.GoldaJeyasheeli, G.Priyanka, S.T.Veena , Problem solving Using C A Structured Programming Approach, Volume I & II, 1st Edition, Cengage Publication, 2022
2. Karl Beecher, Computational Thinking: A Beginner's Guide to Problem Solving and Programming, BCS Learning & Development Limited, 1st Edition, 2017.
3. Byron S. Gottfried, Jitendar Kumar Chhabra, Programming with C, Tata McGraw Hill Publishing Company, New Delhi, 4th Edition, 2018.
4. Kernighan B.W., Ritchie D.M., C Programming Language (ANSI C), Prentice Hall of India Private Limited., New Delhi, 2nd Edition, 2010.
5. Pradip Dey and ManasGhosh, Programming in C, Oxford University Press, New Delhi, 2018.
6. Yashavant P. Kanetkar, Let Us C, BPB Publications,16th Edition, 2020
7. H. M.Deitel, P. J. Deitel, C How to Program, Pearson Education., New Delhi, 7th Edition, 2016.

'L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	ENGINEERING GRAPHICS	L	T	P	E	C
23ME11C	*(Common to MECH, CIVIL, AIDS, EEE, IT)*	2	0	4	0	4

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: Construct the Engineering Curves and Perform Freehand Sketching.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina

CO3: Draw the Projections of Simple Solids in Different Positions.

CO4: Visualize the Sectional Views and Surface of Various Solids.

CO5: Draw the Isometric and Perspective Projections of Various Solids.

CO1: Construct the Engineering Curves and Perform Freehand Sketching. **L:6, P:12**

Principles of Engineering Graphics – significance. Usage of Drawing Instruments. Lettering and dimensioning exercise Construction of ellipse, parabola and hyperbola using eccentricity method– Construction of cycloids, Epi and Hypo-cycloids. Orthographic views of simple components by Free hand drawing - Transferring measurement from the given object to the free hand sketches.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina **L:6, P:12**

Principle of orthographic projections – Conventions - First angle and third angle projections. Projections of points placed in all quadrants – projections of straight lines – inclined to both reference planes - determination of true length and inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes.

CO3: Draw the Projections of Simple Solids in Different Positions. **L:6, P:12**

Projections of simple solids like prisms, pyramids, cylinder and cone - axis inclined to one reference plane - change of position method.

CO4: Visualize the Sectional Views and Surface of Various Solids. **L:6, P:12**

Sectioning of simple solids – Axis perpendicular to horizontal plane- Drawing sectional views with true shape of the section. Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinder and cone.

CO5: Draw the Isometric and Perspective Projections of Various Solids. **L:6, P:12**

Principles of isometric projection – Isometric scale – Isometric projections of simple solids like prism, pyramid, cone and cylinder – Combination of solids. Perspective projections of simple solids by visual-ray method

TEXT BOOKS:

1. Bhatt N.D, “Engineering Drawing”, 54th Edition, Charotar Publishing House, 2023.
2. Shah M.B and Rana B.C, “Engineering Drawing”, Pearson Education, 2nd Edition, 2009.

REFERENCES:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Agrawal B. &Agrawal C.M., “Engineering Graphics”, TMH Publication,2nd Edition, 2013
3. Narayana K.L. &Kannaiah P, “Text book on Engineering Drawing”, Scitech Publishers, 2011.
4. Gopalakrishna K.R, “Engineering Drawing”, Subhas Publications, 32nd Edition, 2017.

L: 30; P: 60; TOTAL: 90 PERIODS

Course Code		L	T	P	E	C
23SH21C	**தமிழரும் தொழில்நுட்பமும் / TAMILS AND TECHNOLOGY**	**1**	**0**	**0**	**0**	**1**

(Common to all B.E. / B.Tech. Degree Programmes)

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: தமிழர்களின் நெசவு மற்றும் பானைத் தொழில் நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில் நுட்பம், உற்பத்தித் தொழில்நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன்.

CO2: தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம், அறிவியல் தமிழ் மற்றும் கணினித் தொழில்நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன்.

Upon the successful completion of the course, the student will be able to

CO1: Know and explain about Tamils weaving and Pottery technology, Design and construction Technology and Manufacturing Technology.

CO2: Know and explain about Tamils Agriculture and irrigation technology, Scientific Tamil and Tamil computing

CO1:தமிழர்களின் நெசவு மற்றும் பானைத் தொழில் நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில் நுட்பம் மற்றும் உற்பத்தித் தொழில் நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:9**

சங்ககாலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிகப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள் - சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்ககாலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோவில்களும் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக்கலை- கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத்தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்கநாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்குமணிகள் - எலும்புத்துண்டுகள் - தொல்லியல்சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

CO1:KNOW AND EXPLAIN ABOUT WEAVING AND CERAMIC TECHNOLOGY, DESIGN AND CONSTRUCTION TECHNOLOGY, MANUFACTURING TECHNOLOGY

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries- Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age — Details of Stage Constructions in Silappathikaram- Sculptures and Temples of Mamallapuram- Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period- Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold Coins as source of history - Minting of Coins — Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences – Gemstone types described in Silappathikaram.

CO2: தமிழர்களின் வேளாண்மை, நீர்ப்பாசனத் தொழில்நுட்பம், அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் பற்றிய அறிவு மற்றும் விளக்கும் திறன். **L:6**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக்குமுழித்தூம் பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு -

மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்- அறிவியல் தமிழின் வளர்ச்சி - கணினித் தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக்கல்விக்கழகம் - தமிழ் மின்நூலகம் - இணையத்தில் தமிழ்அகராதிகள் - சொற்குவைத் திட்டம்.

CO2: KNOW AND EXPLAIN ABOUT AGRICULTURE TECHNOLOGY, IRRIGATION TECHNOLOGY, SCIENTIFIC TAMIL & TAMIL COMPUTING

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing – Knowledge of Sea - Fisheries — Pearl - Conche diving - Ancient Knowledge of Ocean – Knowledge Specific Society- Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books –Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries– Sorkuvai Project.

REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி–வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை–ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறைவெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi-Sangam City Civilization on the banks of river Vaigai (Jointly Published by: Department of Archaeology &Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

L: 15; TOTAL: 15 PERIODS

Course Code	APTITUDE ESSENTIALS	L	T	P	E	C
23GN01C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES:

Upon the completion of the course the students will be able to

CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly

CO2: Develop problem solving skills on Numbers and enhance arithmetic ability

CO3: Infer appropriate comparison and distribution methods using ratio and to form equations
CO4: Improve quantitative skills and solve problems on percentages and profit loss
CO5: Calculate data interpretation and data sufficiency in quantitative aptitude

CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly **L : 3**

Numeric series – Finding missing numbers – Odd number out series - Letter series – Symbol series - Alphanumeric series

CO2: Develop problem solving skills on Numbers and enhance arithmetic ability **L : 3**

Number Types - HCF & LCM – Square root- Cubic root - divisibility criteria- Unit digit calculation- Prime factors

CO3: Infer appropriate comparison and distribution methods using ratio and to form equations **L : 3**

Ratio & Proportion: Comparison of Ratios - Variations: Direct and indirect proportion Ages: Present Age, Past Age & Future calculation

CO4: Improve quantitative skills and solve problems on percentage and profit loss **L : 3**

Concept of Percentage – Percentage calculation - Calculation of Percentage on Population Results on Depreciation .Profit and Loss –Percentage of Profit and Loss – Discount

CO5: Calculate data interpretation and data sufficiency in quantitative aptitude **L : 3**

Data Interpretation – Pie Chart – Bar Chart – Table Chart .Data Sufficiency in Logical Reasoning : Numbers, Ratio, Ages, Percentage and Profit Loss

REFERENCES:

1. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition 2017
2. R.V.Praveen, "Quantitative Aptitude and Reasoning" , 3rd Edition , Eastern Economy Edition, PHI Learning 2016

VIDEO MATERIALS

Profit Loss

https://youtu.be/PpVO7I8dx6U

https://youtu.be/_cW7_BUDYcw

Number series

https://youtu.be/_4ZJFkFE2XU

https://youtu.be/83nJmniFmNk

Numbers

https://youtu.be/81pwuMJ8OIU

https://youtu.be/VT_N9cacgl4

Square root and Cube root

https://youtu.be/nJSqsaT0AgU

https://youtu.be/_HyhwS8P9KY

Problems on Ages

https://youtu.be/6PCTRVmu-ek

https://youtu.be/eAl3BvO_Ipw

Data Interpretation

https://youtu.be/s99rda8e0vc

Course Code	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	E	C
23GN05C	*(Common to all B.E. / B.Tech. Degree Programmes)*	2	0	0	0	2

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: Recognize and practice the core human values and theories related to ethical behavior.

CO2: Analyze the engineering ethical breach from past study.

CO3: Distinguish and apply safety, responsibility and rights in workplaces.

L: 10

CO1: Recognize and practice the core human values and theories related to ethical behavior

Moral dilemmas and moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy –Case studies: Vigil mechanism, Whistle blowing - Protected disclosures - Personal ethics, work ethics and human values - Governing Regulation.

CO2 : Analyze the engineering ethical breach from past study **L: 10**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - Case study: The challenger disaster

CO3 : Distinguish and apply safety, responsibility and rights in workplaces **L: 10**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - Collegiality and loyalty - respect for authority – confidentiality; Collective bargaining, Conflicts of interest - Case study; Occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination. Case studies: The Three mile island and Chernobyl disaster

TEXT BOOK

1. Mike W Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York, 5th Edition, 2022

REFERENCES

1. BehnamTaebi, “Ethics and Engineering: An Introduction”, Cambridge University Press, 2021
2. AjeshFaizal, Aswathy S U, Roy V I, “Professional Ethics in Engineering: an Industry Perspective”, Noor Publishing, 2021
3. R.S.Naagarazan, “A Textbook on Professional Ethics and Human Values”, New age International Pvt. Ltd; 3rd Edition, 2022
4. Dr. P. Elamurugan, “Professional Ethics in Engineering”, Notion Press, 2021

L:30; TOTAL:30 PERIODS

Course Code	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	E	C
23AD21C	*(Common to CSE, IT and AI&DS)*	3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to

Theory Component

CO1: apply the fundamental design techniques of a digital computer to execute simple arithmetic operations

CO2: relate the execution sequence of an instruction to design the datapath and control unit for a processor

CO3: analyze the hierarchical structure of various memory systems and assess the performance
CO4: relate various types of I/O interfaces and their functionalities
CO5: analyze the impact of hazards in pipeline performance by utilizing the different stages of instruction execution in a pipelined processor

CO1: apply the fundamental design techniques of a digital computer to execute simple arithmetic operations **L:10**

Functional units – Basic operational concepts – Bus Structures – Performance – Memory locations and addresses – Instructions and instruction sequencing – Addressing modes.Arithmetic: Addition and Subtraction of Signed Numbers – Design of fast adders –Multiplication of unsigned and signed numbers – Fast Multiplication – Integer division.

CO2: relate the execution sequence of an instruction to design the datapath and control unit for a processor **L:8**

Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Instruction Fetch and Execution Steps – Control Signals – Hardwired control – Micro programmed control.

CO3: analyze the hierarchical structure of various memory systems and assess the performance **L:8**

Basic concepts – RAM – ROM – Cache memories – Improving cache performance – Virtual memory – Memory management requirements – Secondary storage devices.

CO4: relate various types of I/O interfaces and their functionalities **L:8**

Accessing I/O devices – Interrupts – Direct Memory Access – Buses – Interface circuits – Standard I/O Interfaces – PCI, SCSI, SATA, USB– Advanced IO interfaces.

CO5: analyze the impact of hazards in pipeline performance by utilizing the different stages of instruction execution in a pipelined processor **L:11**

Basic concepts – Parallel processing – Instruction pipeline – Data hazards – Instruction hazards – Influence on instruction sets – datapath and control consideration – Super scalar operation – RISC vs CISC processors – Instruction Level Parallelism – Parallel IO Organization – IO in Multicore Computers.

TEXT BOOKS

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, and NaraigManjikian, “Computer Organization and Embedded Systems”, McGraw Hill Higher Education, 6th Edition, 2022.
2. William Stallings, “Computer Organization and Architecture - Designing for Performance”, Pearson Education, 6th Edition, 2021.

REFERENCES

1. David A. Patterson, John L.Hennessy, “Computer Organization and Design, The Hardware / Software Interface”, 6th Edition, Morgan Kaufmann/Elsevier, 2020.
2. M.Morris Mano, “Computer System Architecture”, 3rd Edition, Pearson Education, 2017.
3. John P. Hayes, “Computer Architecture and Organization”, 3rd Edition, Tata McGraw Hill, 2017.
4. Yan Solihin, “Fundamentals of Parallel Multicore Architecture”, CRC Press, 2015.
5. V.P.Heuring, H.F. Jordan, T.G.Venkatesh, “Computer Systems Design and Architecture”, 2nd Edition, Pearson Education, 2008.

ONLINE SOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_cs64/preview
2. https://www.udemy.com/course/computer-organization-and-architecture-j/

L: 45; TOTAL: 45 PERIODS

Course Code	SEMICONDUCTOR PHYSICS AND DIGITAL	L	T	P	E	C
23AD22C	ELECTRONICS	2	0	2	0	3

(Common to IT and AI&DS)

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to

Theory Components:

CO1: Explain the basics of semiconductor.

CO2: Describe the characteristics and applications of pn junction diodes.

CO3: Apply the concepts of Boolean algebra for simplification of logic function.

CO4: Apply the digital concepts to design combinational logic circuits.

CO5: Illustrate the applications of sequential logic circuits.

Lab Components:

CO6: Demonstrate the I-V characteristics of pn junction diodes.

CO7: Demonstrate the verification of Boolean theorem and logic gates.

CO8: Construct basic combinational circuits and verify their functionalities

CO9: Demonstrate the verification of Flip flops.

Soft skill Component:

CO10: Enhance the team work and communication skill through group activities

CO1: Explain the basics of semiconductors.

Band theory of solids– Intrinsic Semiconductors - Carrier concentration and Fermi level in an intrinsic semiconductor – Extrinsic semiconductors - Carrier concentration and Fermi level in N-type and P-type semiconductors. **L:6**

CO2: Describe the characteristics and applications of pn junction diodes.

CO6: Demonstratethe I-V characteristics of pn junction diodes.

Introduction to semiconductor junction - Characteristics and Applications of PN Junction Diode -Experimental characteristics of pn junction diode - Rectifiers – Zener Diode –Experimental characteristics of zener diode - Regulators - Bipolar Junction Transistor – Field Effect Transistor – Optoelectronic device – LED- Experimental characteristics of LED. **L:6** **P:8**

CO3: Apply the concepts of Boolean algebra for simplification of logic function.

CO7:Demonstrate the verification of Boolean theorem and logic gates.

Review of number systems – Binary numbers – Binary arithmetics - Complements – Digital Logic Gates -Experimental verification of logic gates - Basic Theorems and Properties of Boolean Algebra – Boolean Function –Verification of Boolean theorem using logic gates - Simplification of logic functions using Karnaugh Map. **L:5** **P:6**

CO4: Apply the digital concepts to design combinational circuits.

CO8: Construct basic combinational circuits and verify their functionalities

Introduction to combinational logic circuits - Analysis and design- Half adder- Full adder -Design and implementation of binary adder - BCD adder - Half subtractor - Full subtractor - Design and implementation of binary subtractor -Decoder – Encoder - Multiplexers – Demultiplexer – Parity checker - Parity generator. **L:7 P:8**

CO5: Illustrate the applications of sequential logic circuits.

CO9: Demonstrate the verification of Flip flops.

Sequential logic circuit and their operation – Conceptual view of sequential circuits, state tables and diagrams - Latches – Different types of Flip Flops and their state tables, timing diagrams - verification of flip flops - Registers – shift registers – Counters - Applications. **L:6 P:8**

TEXTBOOKS:

1. S. M. Sze and M. K. Lee, Semiconductor Physics and Devices,Wiley, 2021.
2. M. Morris Mano, Michael D. Ciletti, “Digital Design with an Introduction toVerilogHDL”, PHI, 6th Edition, 2018
3. Charles Roth, L.K.John, B.K.Lee, “Digital System Design using Verilog”, Cengage, 1stEdition, 2016.

REFERENCES:

1. S.O.Kasap, Principles of Electronic Materials and Devices, McGraw Hill Education, 2017.
2. Thomas L.Floyd, “Digital Fundamentals”, PHI, 11th Edition, 2017
3. Donald P.Leach, A.P.Malvino, GoutamSaha, “Digital Principles and Applications”,Tata Mc-Graw Hill, 8th Edition, 2014.
4. Charles Roth, L.K.John, B.K.Lee, “Digital System Design using Verilog”, Cengage,1stEdition, 2019.

L: 30; P : 30; TOTAL : 60 PERIODS

Course Code	PROBABILITY AND STATISTICS	L	T	P	E	C
23AD23C		3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: perform basic probability concepts and standard distributions.
CO2: find the correlation and regression of two dimensional random variables.
CO3: calculate the various measures of central tendencies.
CO4: apply the concept of testing of hypothesis for small and large samples.
CO5: apply basic concepts of classification of design of experiments.

CO 1: perform basic probability concepts and standard distributions

Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, and Normal distributions. **L:9,T:3**

CO2: find the correlation and regression of two dimensional random variables

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and regression - Transformation of random variables-Central limit theorem. **L:9,T:3**

CO3: calculate the various measures of central tendencies.

Central tendencies - Mean, median, mode - Measures of Dispersion –Mean deviation, and Quartile deviation–Moments– Skewness –Kurtosis - Correlation and Regression. **L:9,T:3**

CO4: apply the concept of testing of hypothesis for small and large samples

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means – Confidence interval for mean - Tests based on Chi-square distribution - Contingency table for independent of attributes – Goodness of fit. **L:9,T:3**

CO5: apply the basic concepts of classifications of design of experiments

Tests based on t and F distributions for mean, variance and proportion - ANOVA - One way and two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design. **L:9,T:3**

TEXT BOOKS:

1. Richard A. Johnson, Irwin Miller, John Freund, "Miller & Freund's, Probability and Statistics for Engineers," 9th Edition, Pearson Education Limited, Global Edition, 2017.
2. Grewal.B.S., Higher Engineering Mathematics, 44th Edition, Khanna Publications, Delhi, 2017
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

REFERENCE BOOKS:

1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, Asia, 9thEdition, 2016.
2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, Schaum Outlines, Probabilityand Statistics", Tata McGraw Hill Education, 2017.
3. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics, 5thEdition, Narosa Publishing House Private Limited, 2016.
4. Athanasios Papoulis, UnnikrishnaPillai S, Probability, Random variables and Stochastic Processes,4th Edition,Tata McGraw Hill Education, 2017

L: 45 ; T : 15; TOTAL : 60 PERIODS

Course Code	PROFESSIONAL ENGLISH	L	T	P	E	C
23SH22C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**2**	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: extend the primary language skills to develop critical thinking

CO2: build the secondary language skillsfor professional competence

Practical Component

CO3: apply the vital sub-functions of listening in particular context

CO4: take part in propagating ideas through effective oral communication

CO5: inferring information using various reading techniques

CO6: construct professional content via distinct methods of writing

Soft skill Component

CO7: develop interpersonal, communicational and behavioral attributes

CO1:extend the primary language skills to develop critical thinking
CO3: apply the vital sub-functions of listening in particular context **L:6, P:16**
CO4: take part in propagating ideas through effective oral communication

If Conditionals – Standard Abbreviations – Types of Listening (Comprehensive, Informational, Critical Listening) –One Word Substitution, Components of Speaking
Listening for Specific Information –Listening to Speech (Oxford Union Society) – Listening to Science Talks or Theories
Product Description – Chart Description – Process Description – Group Discussion (Uses – Structure – Strategies – Team Work – Positive & Negative Body Languages – Samples – Demo)

CO2:build the secondary language skills for professional competence **L:5, P:18**
CO5: inferring information using various reading techniques
CO6: construct professional content via distinct methods of writing

Synonyms – Intensive and Extensive Reading – Error Spotting (Based on Concord, Pronoun, Articles & Adverb Placement) – Writing Style (Persuasive, Expository & Descriptive)
Newspaper Reading – Reading Comprehension (Fiction &NonFiction)
Business Letters for Quotations and Clarification, Placing Orders and Making Complaints – Proposal Writing – Job Application Letter & Resume Preparation – Paragraph Writing – Content Writing

TEXT BOOKS

1. Lucantoni, Peter & Lydia Kellas. "English as a Second Language Workbook", 6th Edition, Cambridge University Press, 2022.
2. Twain, Mark. "The Adventures of Tom Sawyer", 1st Edition, Pegasus, 2012.
3. Clear, James. "Atomic Habits", 1st Edition, Dreamliners, 2022.
4. Garcia, Hector & Francesc Miralles. Ikigai: The Japanese Secret to a long and Happy Life. 1st Edition, Tuttle Publishing, 2021.
5. Elbow, Peter, "Writing with Power" 2nd Edition, Oxford University Press, 1998.

REFERENCES

1. Butterfield, Jeff. "Soft Skills for Everyone". 2nd Edition, Cengage, 2020
2. Raman, Meenashi & Sangeetha Sharma. Professional English. 1st Edition, Oxford University Press, 2018

L: 11; P: 34; TOTAL: 45 PERIODS

Course Code	BASIC ELECTRICAL AND ELECTRONICS	L	T	P	E	C
23EE11C	ENGINEERING	3	0	2	0	4

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Demonstrate and explain the characteristic parameters of DC and AC circuits.

CO2: Explain the working of AC and DC machines.

CO3: Describe analog and digital instruments for monitoring and control.

CO4: Demonstrate the operation of electronic devices for applications.

CO5: Describe the purpose of safety standards and equipment.

Practical Component

CO6: Analyze the basic electric circuits and characteristics of electrical machines.

CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.

CO8: Perform residential wiring and measure earth resistance.

CO1: Demonstrate and explain the characteristic parameters of DC and AC circuits **L:9,P:6**

Sources - Passive Elements – Electrical Quantities: Voltage, Current, Power and Energy. DC circuits: Ohms Law – Kirchhoff's Laws – Mesh analysis. AC Circuits: Waveforms, RMS, Peak, real power, reactive power and apparent power, power factor.

CO6: Analyze the basic electric circuits and characteristics of electrical machines

1. Verification of Ohms law & Kirchhoff law.
2. Measurement of power and power factor for R, L load

CO2: Explain the working of AC and DC machines **L:9, P:6**

Machines: Construction, Types of DC motors – Working Principles – Need for Starters - AC Motors: Construction and Working of Single Phase and Three Phase Induction Motor– Servomotor -Stepper motor.

CO6: Analyze the basic electric circuits and characteristics of electrical machines

1. Analyze the characteristics of DC Shunt Motor and DC series motor
2. Distinguish the operation of single phase and three phase induction motor

CO3: Describe analog and digital instruments for monitoring and control **L:9, P:6**

Analog instruments: Functional Elements, Principles: PMMC, MI, Electrodynamometer wattmeter – Digital voltmeter - multimeter – DSO – Digital Energy meter - Multifunction meter.

CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.

1. Calibration of single phase energy meter using wattmeter
2. Measurement of AC signal parameter (Peak-Peak, RMS, Period and Frequency) using DSO

CO4: Demonstrate the operation of electronic devices for applications **L:9, P:6**

Characteristics and applications: Diode – Rectifiers, Zener Diode – Regulators, BJT - Configuration, Amplifier – LEDs – Photo Diodes, Opto-Isolators.

CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.

1. Experimental Verification of PN Junction diode as rectifier.
2. Experimental Verification of Zener Diode as Voltage Regulators.
3. Input and Output Characteristics of BJT in CE Configuration.

CO5: Describe the purpose of safety standards and equipment **L:9, P:6**

Electric shock -Protection: PPE, Switches, Plug and Socket, Fuse, MCB, ELCB, MCCB and Earthing - Types of wires and cables - Energy storage devices - Inverters – UPS - Energy Consumptions and Battery Charging system – Electrical safety standards in IT industry – Schematic Electrical Layout of Computer Lab with battery backup.

CO8: Perform residential wiring and measure earth resistance

1. Measurement of Earth Resistance using Electrical Equipment.
2. Harness residential house wiring, staircase wiring and fuse connections

TEXT BOOKS:

1. D.P. Kothari and I J Nagrath, "Basic Electrical and Electronics Engineering", Tata McGraw Hill, 4th Edition, 2019.
2. R.K.Rajput, "Basic Electrical and Electronics Engineering", University Science Press, 2017.

REFERENCES:

1. Lionel Warnes, "Electrical and Electronics Engineering: Principles and practice, Palgrave Macmillan publication, 3rd Edition, 2003.
2. D.C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, Revision 1st Edition, 2011.
3. David Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
4. Mohamed A. El-Sharkawi, "Electric Safety Practice and Standards", Taylor & Francis, 2013.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	PYTHON PROGRAMMING	L	T	P	E	C
23AD24C		3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the students will be able to

Theory Component

CO1: Construct simple programs using fundamental concepts.

CO2: Apply control logic statements and functions for solving real time problems.

CO3: Implement the concepts of lists, tuples and sets.

CO4: Develop programs using file concepts and modules.

CO5: Apply different packages for solving different data analytics applications.

Practical Component

CO6: Develop and execute simple Python programs.

CO7: Implement programs in Python using control flow structures and functions.

CO8: Evaluate application programs using Python collections.

CO9: Apply modules and files concepts effectively in different problem solving contexts.

CO10: Design and develop a mini project for a real time application by applying Python packages.

Softskill Component

CO11: Demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation process

CO1: Construct simple programs using fundamental concepts.

CO6: Develop and execute simple Python programs.

Introduction-Data types- variables – expressions- statements -tuple assignment - precedence of operators - comments - Modules and functions- flow of execution - parameters and arguments. **L:9, P:4**

CO2: Apply control logic statements and functions for solving real time problems.

CO7: Implement programs in Python using control flow structures and functions.

Conditionals: Boolean values and operators - conditional (if) - alternative (if-else) - chained conditional (if-elif-else) - Looping: state - while - for - break - continue - pass - Fruitful functions: Function argument and its types - return values - parameters - local and global scope - function composition - recursion-lambda functions- Introduction to OOPs: Classes - Objects-Method overloading-Method overriding . **L:9,P:6**

CO3: Implement the concepts of lists, tuples and sets.

CO8: Evaluate application programs using Python collections.

Strings: string slices - immutability - string functions and methods - string module - Lists: list operations - list slices - list methods - list loop - mutability -aliasing - cloning lists - list Parameters - Lists as arrays - Tuples: tuple assignment - tuple as return value - Dictionaries: operations and methods - advanced list processing - list comprehension - Sets: Creation - Operations and methods - Set comprehension. **L:9;P:5**

CO4: Develop programs using file concepts and modules.

CO9: Apply modules and files concepts effectively in different problem solving contexts. **L:9,P:5**

Files and exception: text files – readand write - format operator - command line arguments - errors and exceptions - Handling of exceptions - Modules.

CO5: Apply different packages for solving different data analytics applications.

CO10: Design and developa mini project for a real time application Python packages.

CO11:Demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation processPackages: Numpy Basics - N-dimensional Array in NumPy - Methods and Properties - Basics of SciPy - Broadcasting in NumPy Array Operations - Array Indexing in NumPy - Pandas: Introduction - Series –DataFrame - Matplotlib: Basics - Figures and Axes - Method subplot() - Axis container - Histogram. **L:9,P:10**

TEXTBOOKS:

1. Eric Matthes, “Python Crash Course: A Hands-On, Project-Based Introduction to Programming”, William pollock publisher, 3rd Edition, 2023.
2. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition**,** 2019.

REFERENCES:

1. Paul Barry, "Head First Python: A Learner's Guide to the Fundamentals of Python Programming, a Brain-Friendly Guide", O'Reilly Media, Inc.,3rd Edition, 2023.
2. Richard L.Halterman, "Fundamentals of Python Programming", Southern Adventist University and Internet Archive, 2nd Edition, 2019.
3. Allen B.Downey, "Think Python: How to Think Like a Computer Scientist", O'Reilly Media, Inc., 1st Edition, 2016.
4. G.Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", Notion Press, 1st Edition, 2021.

L: 45;P:30; TOTAL: 75 PERIODS

Course Code	INNOVATION THROUGH DESIGN THINKING	L	T	P	E	C
23GN02C	*(Common to all B.E. / B.Tech. Degree Programmes)*	0	0	0	4	2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Experiential Component

CO1: Analyse the impact of design thinking process.

CO2: Practice design thinking process through real world problems.

Soft skill Component

CO3: Present survey conclusions on selected real-world problems.

CO1: Analyse the impact of design thinking process **30**

Design thinking process: history and phases -Ideation tools: brainstorming, mind mapping, scrambler method, six thinking hats -case studies.

CO2: Practice design thinking process through real world problems **30**

Real world problem selection-Practicing the preliminary stages of design thinking process - work presentation.

TEXT BOOKS

1. Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef, "Design Thinking: The Handbook", WS Professional, 2020
2. PavanSoni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving", Penguin Random House, 2020

REFERENCES

1. Michael Lewrick, "The Design Thinking Playbook", Wiley, 2019
2. Kathryn Christopher, "Design Thinking in Engineering", Kendall Hunt Publishing Company,2019
3. Robert Curedale, "Design Thinking Process & Methods" Design Community College Inc, 5th Edition, 2019
4. David Lee, "Design Thinking in the Classroom", Ulysses Press, 2018
5. Jimmy Jain, "Design Thinking for Startups", Notion Press, 2018
6. Monika Hestad Silvia Rigoni Anders Grnli, "The Little Booklet on Design Thinking: An Introduction", Zaccheus Entertainment, 2nd Edition, 2017

7. Scott Swan, Michael G.Luchs and Abbie Griffin, "Design Thinking: New Product Development Essentials", Wiley-Blackwell, 2016
8. D.M. ArvindMallik, "Design Thinking for Educators", Notion Press, 2019

E:60; TOTAL:60 PERIODS

CourseCode	OPERATING SYSTEMS	L	T	P	E	C
23AD31C	*(Common to CSE, IT and AI&DS)*	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: conceive the basic components and working principles of operating systems.
CO2: analyze CPU scheduling mechanisms for diverse scheduling criteria
CO3: devise the solutions for process synchronization issues.
CO4: relate various techniques for handling memory management.
CO5: apply file management and I/O management techniques.

CO1: conceive the basic components and working principles of operating systems. **L:6; T:1**

Introduction to operating systems - Types of operating system - structure of OS – system calls and its types – system programs – Processes : Concept – Process scheduling – operations on processes – Threads : concept – multithreading models – Inter process communication – Processes and threads in Linux os-Free and Open source-***Overview: Windows, Linux, Mobile, Real-Time, and Robotic Operating Systems.***

CO2: analyze CPU scheduling mechanisms for diverse scheduling criteria **L:6; T:3**

CPU Scheduling – basic concepts – scheduling criteria – Preemptive and non-preemptive scheduling algorithms: FCFS, SJF, Priority, Round Robin – scheduling in Real Time Operating System (RTOS) – Rate Monotonic (RM) scheduling algorithm – Least Laxity First (LLF) scheduling algorithm **– *Simulation of process scheduling.***

CO3: devise the solutions for process synchronization issues. **L:6; T:3**

Process Synchronization – The Critical – Section problem – Peterson's solution – Mutex locks –concurrency - Semaphores – Classic problems of synchronization – monitors. Deadlock: System model – deadlock characterization – Methods for handling deadlock – deadlock prevention – deadlock avoidance – banker's algorithm – deadlock detection – recovery from deadlock.

CO4: relate various techniques for handling memory management. **L:6, T:4**

Memory management – Background – Swapping – Contiguous memory allocation – Segmentation – Paging – Segmentation with paging – Intel 32 and 64 bit Architectures-Virtual memory: Background – Demand paging – page replacement – algorithms: FIFO, LRU, Optimal-allocation of frames – thrashing-***Case Study on Redis page replacement approach.***

CO5: apply file management and I/O management techniques. **L:6, T:4**

File concept – Access methods – directory and disk structure – file system mounting – protection – File system implementation: Directory implementation – Allocation

methods – Free space management. Disk scheduling – Algorithms: FCFS, SSTF, SCAN, CSCAN, LOOK, CLOOK – disk management.

TEXT BOOK

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, "Operating System Concepts", Enhanced eText, 10th Edition , Wiley Asia Student Edition, 2018.

REFERENCES

1. William Stallings, "Operating Systems: Internals and Design Principles", 9th edition, Prentice Hall of India, 2018.
2. Andrew S. Tanenbaum, Modern Operating Systems, Pearson, 4th Edition (2016).
3. Anderson, Thomas, and Dahlin, Michael. Operating Systems: Principles and Practice", 2nd Edition, United Kingdom, Recursive Books, 2014.
4. https://onlinecourses.nptel.ac.in/noc22_cs104/preview

L: 30; T: 15; TOTAL:45 PERIODS

Course Code		L	T	P	E	C
23AD32C	**DATA WAREHOUSING AND DATA MINING**	3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: explore the fundamental concepts of data warehousing.(CDL-1)

CO2: explore the fundamental concepts of data mining tasks. (CDL-1)

CO3: solve various preprocessing techniques in order to extract the vital data for further processing.(CDL-2)

CO4: employ the association of data in frequent data items using association rules. (CDL-1)

CO5:execute various data mining models using tools.(CDL-2)

CO1: explore the fundamental concepts of Data warehousing. **L:9**

Data Warehousing: Data warehousing components – Building a Data Warehouse – OLAP vs OLTP. Multidimensional data model: Data cubes – DBMS Schemas for Decision Support – OLAP operations – Data warehousing architecture – Data Extraction, Cleanup, and Transformation Tools – reporting – Query tools and Applications.

CO2: explore the fundamental concepts of data mining tasks. **L:9**

Fundamentals of data mining: Data Mining functionalities – Classifications of Data Mining Systems – Task Primitives – Major issues in Data Mining.

CO3: solve various preprocessing techniques in order to extract the vital data for further processing. **L:9**

Data Preprocessing: Need of preprocess of data – Data cleaning methods – Data integration and transformation techniques – Data reduction – Data discretization and Concept hierarchy generation – Accuracy and Error measures – Confusion Matrix.

CO4: employ the association of data in frequent data items using association rules. **L:9**

Association Rule Mining: Market Basket Analysis – Frequent pattern mining –

Apriori algorithm – Generating Association rules from frequent items – Improving the efficiency of Apriori algorithm – Mining Multilevel association rules – Multidimensional association rules – Constraint based association Mining.

CO5: execute various data mining models using tools **L:9**

Multidimensional analysis: Spatial data mining – Temporal data mining – Multimedia data mining - Text mining – Web Mining – **Tools:** R Programming and python.

TEXT BOOKS

1. Jiawei Han, Micheline Kamber, "Data Mining Concepts and Techniques", 4th Edition, Morgan Kaufmann Publishers, 2022.
2. Alex Berson and Stephen J.Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, 36th Reprint 2017.

REFERENCES

1. K.P. Soman, Shyam Diwakar and V. Ajay, "Insight into Data mining Theory and Practice", 2nd Edition, Prentice Hall of India, 2006.
2. G. K. Gupta, "Introduction to Data Mining with Case Studies", 2nd Edition, Prentice Hall of India, 2011.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", 2nd Edition, Pearson Education, 2007.

ONLINE SOURCES:

1. https://www.udemy.com/course/datamining
2. https://www.coursera.org/specializations/data-mining

L: 45; TOTAL:45 PERIODS

Course Code	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	**L**	**T**	**P**	**E**	**C**
23MC02C		**2**	**0**	**0**	**0**	**0**

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: explain the structure and functions of an ecosystem and the importance of biodiversity.

CO2: interpret the causes, effects of air and water pollution.

CO3: comprehend the causes, impacts and management of e-waste and municipal waste.

CO4: apply the knowledge of sustainability practices in the environment.

CO1: explain the structure and functions of an ecosystem and the importance of biodiversity. **L-6**

Introduction to Environment**,** scope and importance of environment – need for public awareness. Eco-system: structure and function. Biodiversity: Introduction - types – values of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India. Conservation of biodiversity: In-situ and ex-situ - Biodiversity index calculation (Simpson and Shannon diversity Index, Sorenson coefficient)

CO2: interpret the causes, effects of air and water pollution. **L-6**

Air pollution - Classification of air pollutants – sources – Effects - Measurements: dust monitor – gas analyzer, particle size analyzer. Water pollution – Classification – health

hazards – sampling and analysis of water. Waste water treatment – different industrial effluents and their treatment – Measurement: BOD and COD – atomic absorption spectrometer. Case study (Okhla sewage water treatment plant)

CO3: comprehend the causes, impacts and management of e-waste and municipal waste. **L-12**

Integrated Waste Management: Introduction – Generation and types of solid waste – Swachh Bharat Mission – Solid waste management: collection, transportation, segregation and processing – Disposal: landfill – biochemical processes and energy recovery - Municipal solid waste management rules 2016.

e-Waste Management: Introduction – Composition - Types – Generation – Environmental and health hazards of e-waste – Recycling - Recovery of metals: pyrometallurgical, hydrometallurgical, and biometallurgical process – e-waste management and handling rules 2016 – e-waste management companies in India.

CO4: apply the knowledge of sustainability practices in the environment. **L-6**

Sustainability and Management**:** Introduction - concept, needs and challenges –economic and social aspects of sustainability – unsustainability to sustainability –millennium development goals and protocols – Sustainable Development Goals-targets, indicators and intervention areas – Climate change – Global, Regional and local environmental issues and possible solutions – case studies. Concept of Carbon Credit – Carbon Footprint – Environmental management in industry – A case study – Zero waste and R concept – Circular economy – ISO 14000 Series – Material Life cycle assessment.

TEXT BOOKS:

1. Miller. G.T and Spoolman. S, 'Environmental Science', 16th Edition, Brooks/Cole Publishing Co., 2018.
2. Peavy. H.S, Rowe. D.R and Tchobanoglous. G, 'Environmental Engineering', 2nd Edition, McGraw Hill Education, 2020.
3. Benny Joseph, 'Environmental Engineering', Tata-Mc-Graw Hill, New Delhi, 2016.
4. Gilbert M. Masters, 'Introduction to Environmental Science and Engineering', 2nd Edition, Pearson Education, 2016.

REFERENCES:

1. Kaushik. A and Kaushik. C.P, 'Environmental Science and Engineering', 6th Edition, New Age International Publishers, 2018.
2. Weller. K, 'Environmental Science and Biological Engineering', 1st Edition, WIT Press, 2015.

L:30; TOTAL : 30 PERIODS

Course Code		L	T	P	E	C
23AD33C	**LINEAR ALGEBRA**	**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Solve the linear system of equations.

CO2: Analyze concepts of vector spaces.

CO3: Measure the similarity between different datasets using Inner product spaces.

CO4: Illustrate Jordan canonical form on a finite dimensional vector space.
CO5: Decompose the matrix for computational convenience and analytic simplicity.

CO 1: Solve the linear system of equations

General system of linear equations – Matrices– Echelon form of matrix- Solving linear systems- Consistency of a system of linear equations -LU factorization- Applications of system of linear equations- generating codes with matrices. **L:9, T:3**

CO2: Analyze concepts of vector spaces

Vector spaces – Subspaces – Linear combinations – linear span - Linear independence and linear dependence – Bases and dimensions. **L:8, T:3**

CO3:Measure the similarity between different datasets using Inner product spaces

Linear transformation - Null spaces and ranges – Rank Nullity Theorem - Matrix representation of linear transformations - Inner product space - Norms - Orthonormal Vectors - Gram Schmidt orthogonalisation process. **L:9, T:3**

CO4: Illustrate Jordan canonical form on a finite dimensional vector space

Generalized eigenvector- Application : Spring and mass in 2D –Chains- Canonical basis the minimum polynomial- - Algebraic and Geometric multiplicity of Eigen Values - Similar matrices-Modal matrix-Jordan canonical form- similarity and Jordan canonical form-Functions of matrices - Carry out performance study on Jordan canonical form – Activity through software. **L:10,T:3**

CO5:Decompose the matrix for computational convenience and analytic simplicity

Eigen-values using QR transformations – Generalized Inverse Eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse – Moore – Penrose Inverse - Least square approximations - Compute the decomposition of the matrix – Activity through software. **L:9, T:3**

TEXT BOOKS:

1. Bernard Kolman and David Hill, "Elementary Linear Algebra with Application" Pearson Modern Classic, 9th Edition, 2019
2. Seymour Lipschutz Marc Lipson, " Linear Algebra", Schaum's Outlines series, 6th Edition, 2017

REFERENCES:

1. Friedberg, A.H., Insel,A.J.and Spence,L., Elementary Linear Algebra, a matrix approach, 2nd Edition, Pearson Publishers, 2014
2. Jim Defranza, Daniel Gagiardi, "Introduction to Linear Algebra with Applications", Mc-Graw Hill Education, 2014
3. Edgar G Goodaire, "Linear Algebra Pure & Applied", World Scientific, New Delhi 2014
4. Raju.K.George and AbhijithAjayakumar, "A course in Linear Algebra", Springer,2024

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	OBJECT ORIENTED PROGRAMMING WITH	L	T	P	E	C
23AD34C	JAVA	3	0	2	0	4

COURSEOUTCOMES

Upon the successful completion of the course, the students will be able to

Theory Component

CO1: Apply fundamentals of oops concepts to develop simple programs using Java.

CO2: Design effective application with inheritance, interfaces and packages.

CO3: Apply I/O streams, threads concepts and string handling methods for developing simple programs.

CO4: Analyze various collections framework and collection interface for solving real time problems.

CO5: Employ problem solving skills using JAVAFX for developing web applications.

Practical Component

CO6: Apply Object oriented programming concepts for developing simple problems.

CO7: Implement code reusability through overloading, inheritance, interfaces and packages.

CO8: Demonstrate a comprehensive understanding of programming concepts on exception handling, files and streams concepts.

CO9: Design and develop programs using collection framework and collection interface.

CO10: Create a web/desktop application with appropriate JAVAFX components with event handling mechanisms using JDBC.

Softskill Component

CO11: Demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation process

CO1:Apply fundamentals of oops concepts to develop simple programs using Java. **L:7,P:5**

CO6:Apply Object oriented programming concepts for developing simple problems.

Overview of OOPs concepts - Features of OOPS - Overview of JAVA: Objects and Classes - Data Types – Variables - Arrays - Operators - Control statements - constructors - methods - Access specifiers- static members.

CO2: Design effective application with inheritance, interfaces and packages. **L:9,P:5**

CO7: Implement code reusability through overloading, inheritance, interfaces and packages.

Method Overloading and overriding - Objects as Parameters - Returning Objects - Static, Nested and Inner Classes - Dynamic Method Dispatch - Inheritance: Basics - Types of Inheritance - Super keyword - Abstract class - final with Inheritance - Interfaces - Packages - Packages and Member Access - Importing packages.

CO3: Apply I/O streams, threads concepts and string handling methods for developing simple programs. **L:10,P:6**

CO8:Demonstrate a comprehensive understanding of programming concepts on exception handling, files and streams concepts

CO11:Demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation process

Exception Handling - Threads: Life Cycle - Creating Thread Using Thread Class and Runnable Interface – Thread Priorities - Multi threading - Strings: string methods – string comparison –string Buffer vs string Builder - Buffered Reader/Writer – File Input Stream – File Output Stream.

CO4: Analyze various collection framework and collection interface for solving real time problems. **L:10, P:6**

CO9: Design and develop programs using collection framework and collection interface.

Collection framework - Collection Class: ArrayList, HashMap, Set, LinkedList – Iterationin collection - Collection Interface: List, Map - class - Filter - Optional Class – Mapoperations – Flatmap operations - Regular Expression- sort a collection using ComparableandComparatorInterface-Aggregationoperations-min,maxoperations.

CO5:Employ problem solving skills using JAVAFX for developing web applications. **L:9, P:8**

CO10: Create a web/desktop application with appropriate components with event handling mechanisms using JDBC.

JDBC: Architecture-database connectivity - JavaFX: Introduction - Architecture - JAVAFX controls - Text controls - Event Basics - Handling Key and Mouse Events – JavaFX Event Handling.

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", McGraw Hill Education, 12th Edition, 2021.
2. Herbert Schildt, "Introducing JavaFX 8 Programming", McGraw Hill Education, 1st Edition, 2023.

REFERENCES:

1. E.Balagurusamy, "Programming with Java", McGraw Hill Education, 6thEdition, 2021.
2. CayS. Horstmann, "Core Java Fundamentals" Volume1, Pearson, 11th Edition, 2020
3. Hortsmann & Cornell, "CORE JAVA 2 Advanced Features – Volume 2", Oracle Press, 12th Edition, 2022.

L:45;P:30;TOTAL:75PERIODS

Course Code	DATA STRUCTURES	L	T	P	E	C
23AD35C		3	0	2	0	4

COURSE OUTCOMES

Upon completion of the course, students will be able to:

Theroy Component

CO1: Apply appropriate linear data structures for different applications

CO2: Apply the concepts of linked lists for solving real time problems.

CO3: Implement various tree operations for handling nonlinear data organization.

CO4: Perform indexing and hashing techniques and implement dictionary operations.

CO5: Apply graph data structure concepts for real time applications.

Practical Component

CO6: Design and develop Stack ADT and queue ADT programs and implement their operations.

CO7: Perform operations on linked list and perform complexity analysis.
CO8: Demonstrate a comprehensive understanding of programming concepts by proficiently executing various Non-linear data structures.
CO9: Showcase proficiency in developing and optimizing programs on Indexing, hashing, Dictionary and its sorting and searching to solve complex problems.
CO10: Implement various graph and its traversal techniques for solving network problems.

CO1: Apply appropriate linear data structures for different applications
CO6: Design and develop Stack ADT and queue ADT programs and implement their operations.

Introduction – Abstract Data Types – Arrays: Operations – Stack ADT – Operations – Applications – Evaluating arithmetic expressions: Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues – Complexity analysis – Implementation of Stacks and Queues using array. **L:9;P:6**

CO2: Apply the concepts of linked lists for solving real time problems.
CO7: Perform operations on linked list and perform complexity analysis.

Introduction – List ADT–singly linked lists–Operations: Insertion, Deletion, Traversal–doubly linked lists – circular linked lists – applications of linked lists – Complexity Analysis – Implementation of Stacks and Queues using Linked lists. **L:8;P:6**

CO3: Implement various tree operations for handling nonlinear data organization.
CO8: Demonstrate a comprehensive understanding of programming concepts by proficiently executing various Non-linear data structures.

Introduction – Binary Tree – Operations – Tree Traversals – Binary Search Tree – Operations – Expression tree – AVL Tree: Single and double rotations – Applications of trees – Complexity Analysis – Tries: Operations of Trie. **L:9;P:6**

CO4: Perform indexing and hashing techniques and implement dictionary operations.
CO9: Showcase proficiency in developing and optimizing programs on Indexing, hashing, Dictionary and its sorting and searching to solve complex problems.

Indexing: B Tree – B+ tree **–** algorithms – Splay tree – Rotations. Hash tables: Linear probing – Chaining the elements – Implementation – Applications. Dictionary: Operations – Implementation – Complexity analysis – Applications of Dictionary. Sorting: Bubble sort – Quick sort – Insertion sort. Searching: Linear search and Binary search. **L:9;P:8**

CO5: Apply graph data structure concepts for real time applications.
CO10:Implement various graph and its traversal techniques for solving network problems.

Graph components – Representation of Graph – Types of graphs – Graph traversal algorithms – Implementation of Graphs – Topological Sorting – Spanning Tree: Prim's algorithm – Kruskal's algorithm – Shortest Distance: Dijkstra's algorithm – Graph connectivity – Applications of Graph – Complexity Analysis. **L:10;P:4**

TEXT BOOKS

1. Dr Shriram K. Vasudevan, Mr Abhishek S. Nagarajan, "Data Structures using Python", Oxford, 1st Edition, 2021.
2. Mark Allen Weiss, "Data structures and Algorithm Analysis in C", Pearson publication, 2nd Edition, 2020.

REFERENCES

1. Ellis Horowitz, SartajSahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C, Universities Press, 2nd Edition, 2008.
2. R. Venkatesan, S. LovelynRose, "Data Structures", Wiley Publications, 2nd Edition, 2019.
3. Kenneth Lambert, "Fundamentals of Python: Data Structures", Course Technology Inc Publications, 2nd Edition, 2018.

L:45;P:30;TOTAL:75 PERIODS

Course Code		L	T	P	E	C
23AD36C	**ARTIFICIAL INTELLIGENCE**	**3**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the students will be able to

Theory Component

CO1: Apply fundamental concepts of Intelligent agents for real time applications.

CO2: Analyze problem solving techniques in AI.

CO3: Analyze fundamental concepts of game playing and CSP techniques.

CO4: Build the logical reasoning models in different automation contexts showcasing adaptability and creativity.

CO5: Apply probabilistic reasoning under uncertainty environments.

Practical Component

CO6: Develop applications by integrating intelligent agent concepts and search strategies to meet customer needs.

CO7: Evaluate game playing concepts and CSP techniques.

CO8: Demonstrate arobotic application by performing logical reasoning

CO9: Implement real time applications using probabilistic reasoning.

CO10: Design and develop a mini project using AI techniques for real world applications.

Soft skill Component

CO11: Demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation process

CO1: Apply fundamental concepts of Intelligent agents for real time applications. L:9

Intelligent Agents: Introduction to AI - Agents and Environments - concept of rationality - nature of environments - structure of agents. Problem solving agents - search algorithms - uninformed search strategies.

CO2: Analyze problem solving techniques in AI. L:9,P:6

CO6: Develop applications by integrating intelligent agent concepts and search strategies to meet customer needs

Problem solving by search: Heuristic search strategies - heuristic functions. Local search and optimization problems - local search in continuous space - search with non-

deterministic actions - search in partially observable environments - online search agents and unknown environments.

CO3: Analyze fundamental concepts of game playing and CSP techniques. L:9,P:6

CO7: Evaluate game playing concepts and CSP techniques

Advanced Search: Games- optimal decisions in games - alpha-beta search - monte-carlo tree search - stochastic games - partially observable games. Constraint satisfaction problems: Introduction - constraint propagation - backtracking search for CSP - local search for CSP - structure of problems.

CO4: Build the logical reasoning models in different automation contexts showcasing adaptability and creativity. L:9,P:8

CO8: Demonstrate a robotic application by performing logical reasoning

CO11: Demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation process

Logical agents: Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic: syntax and semantics – knowledge engineering – Inferences in first-order logic: forward chaining – backward chaining – resolution.

CO5: Apply probabilistic reasoning under uncertainty environments. L:9,P:10

CO9: Implement real time applications using probabilistic reasoning.

CO10: Design and develop a mini project using AI techniques for real world applications.

Uncertain knowledge and reasoning: Acting under uncertainty - Bayesian inference - naïve Bayes models. Probabilistic reasoning - Bayesian networks - exact inference in BN - approximate inference in BN - causal networks.

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education, 4th Edition, 2021.
2. Utpal Chakraborty, "Artificial Intelligence for All: Transforming Every Aspect of Our Life", BPB Publications, 1st Edition , 2020.

REFERENCES:

1. John Paul Mueller, Luca Massaron, "Artificial Intelligence For Dummies", John Wiley & Sons, Inc, 2nd Edition, 2022.
2. Khemani D, "A First Course in Artificial Intelligence", McGraw Hill Education (India) Private Limited, 1st Edition, 9th reprint, 2019.

L: 45;P:30; TOTAL: 75 PERIODS

Course Code	LINUX SYSTEM ADMINISTRATION	L	T	P	E	C
23AD37C	*(Common to CSE, IT and AI&DS)*	0	0	2	0	1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1:demonstrate the basic knowledge of Linux commands and file handling utilities by using Linux shell environment

CO2:implement Shell Scripting

LIST OF EXPERIMENTS

Explore the LINUX Commands **P:6**

a. Directory
b. File Manipulation
c. General-purpose
d. Network utilities
e. Disk utilities
f. Backup utilities and Filters

Shell Programming - Develop Shell script programs for the following: **P:10**

a. Interactive shell script
b. Positional parameters
c. Arithmetic
d. If-then-fi, if-then-else-fi, & nested if-else
e. Logical operators
f. Else + if equals elif, case structure
g. While & for loop
h. Meta characters

Shell scripting for - Real world problem solving **P:14**

a. File Backup
b. Text File Search
c. Password Generator
d. Disk Cleanup
e. Memory Leak Detection
f. Cache Management
g. Swap Space Optimization

SOFTWARE REQUIREMENTS

Operating System: Linux (Ubuntu).

REFERENCES

1. Venkateshmurthy, "Introduction to Unix and Shell Programming", 1st Edition, Pearson Publisher India, 2016.
2. Behrouz A. Forouzan, Richard F.Gilberg, Unix and shell Programming, 1st Edition Thomson Publisher, 2013.
3. Andrew S. Tanenbaum, Modern Operating Systems, 4th Edition, Pearson Education, 2014.
4. Robert Love, Linux System Programming - Talking Directly to the Kernel and C Library, O'Reilly Media, 2013.

P: 30 TOTAL: 30 PERIODS

Course Code	INTELLECTUAL PROPERTY RIGHTS STUDY	L	T	P	E	C
23GN03C	*(Common to all B.E. / B.Tech. Degree Programmes)*	**0**	**0**	**2**	**2**	**2**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1:Understand the basic concepts and types of Intellectual Property Rights

CO2: Outline the Indian position of the patent law (1970)

CO3:Identify and investigate the state of art technologies through effectual IP search

CO1 : Understand the basic concepts and types of Intellectual Property Rights **20**

Introduction to Intellectual Property Rights - Concept and Theories - Kinds of Intellectual Property Rights - Economic analysis of Intellectual Property Rights - Need for Private Rights versus Public Interests - Advantages and Disadvantages of IPR

CO2 : Outline the Indian position of the patent law (1970) **20**

Patent Act 1970 – amendments of 1999, 2000, 2002 and 2005 - Patent able subject matter, Patentability criteria, non-patentable inventions - Pharmaceutical products and process and patent protection - Software Patents

CO3 : Identify and investigate the state of art technologies through effectual IP search **20**

Importance of IP search - factors to be considered for effective IP search - Hands-on Practice

P:30;E:30; TOTAL:60 PERIODS

REFERENCE BOOKS

1.D.P.Mittal (Taxman Publication), Indian Patents Law and Procedure (2002)
2.B.L.Wadera, Patents, trademarks, copyright, Designs and Geographical Judications (2010)
3.P.Narayanan (Eastern Law House), Intellectual Property Law(2022)
4.N.S.Gopalakrishnan &T.G.Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow

Course Code		L	T	P	E	C
23AD41C	**DESIGN AND ANALYSIS OF ALGORITHMS**	3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: apply algorithmic analysis techniques to evaluate the efficiency of algorithms in terms of time and space complexities.

CO2: analyze algorithmic design using divide and conquer/greedy approach to solve complex problems.

CO3: derive optimal solutions for complex problems using dynamic programming.

CO4: use branch and bound and backtracking strategies along with the state space tree method to solve complex problems.

CO5: apply polynomial time algorithms to solve problems efficiently within reasonable time bounds.

CO1: apply algorithmic analysis techniques to evaluate the efficiency of algorithms in terms of time and space complexities **L:10**

Notion of an Algorithm - Time and Space Complexity - Asymptotic notation and its properties - Recurrence Relations - The substitution method for solving recurrences - The master method for solving recurrences - Algorithm Analysis: Sorting Techniques - Towers of Hanoi, Sieve of Eratosthenes

CO2: analyze algorithmic design using divide and conquer/greedy approach to solve complex problems **L:9**

Divide-and-Conquer: Introduction - Algorithm Analysis: Binary Search, Merge sort, Quick sort - Strassen's algorithm for matrix multiplication - Closest pair of points - Randomized Quick Sort.

Greedy Method: Introduction - Activity Selection Problem - Huffman Trees - Minimum spanning tree: Prim's and Kruskal's - Knapsack problem

CO3:derive optimal solutions for complex problems using dynamic programming **L:10**

Approaches of dynamic programming - Principle of Optimality - Computing Binomial Coefficient - Multi-stage graph - Floyd-Warshall algorithm - Matrix chain multiplication - 0/1 Knapsack problem - Optimal binary search tree - Longest common subsequence.

CO4: use branch and bound and backtracking strategies along with the state space tree method to solve complex problems **L:9**

Back tracking: Introduction to backtracking - N-Queens Problem - Hamiltonian Circuit Problem - Graph coloring problem - Knight's tour Problem.

Branch and Bound: Introduction - Classification of Branch and Bound Problems: FIFO, LIFO, LC - 0/1 Knapsack problem - Solving 8-Puzzle problem

CO5: apply polynomial time algorithms to solve problems efficiently within reasonable time bounds **L:7**

Tractable and Intractable Problems - Complexity Classes - NP hardness: Clique decision problem - NP Completeness - Concept of Cooks Theorem - Proof of NP Completeness: CNF-SAT, Vertex Cover, Subset-Sum Problem

TEXT BOOKS:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest and Clifford Stein, "Introduction to Algorithms", 4th Edition, Prentice Hall of India, 2022.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2019.

REFERENCE BOOKS:

1. Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran "Computer Algorithms" Orient Blackswan, 2nd Edition, 2019.
2. SandeepSen, Amit Kumar, "Design and Analysis of Algorithms A Contemporary Perspective, 1st Edition, Cambridge University Press, 2019.
3. Jon Kleinberg and Eva Tardos, "Algorithm Design", 1st Edition, Pearson/Addison-Wesley, 2014.
4. Dave, P.H, "Design and Analysis of Algorithms", 1st Edition, Pearson Education Canada, 2007.

L:45;TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23AD42C	DATA EXPLORATION AND VISUALIZATION	3	0	0	0	3

COURSEOUTCOMES

Upon completion of this course, the student will be able to

CO1: explore the fundamentals of exploratory data analysis.

CO2: implement the data visualization techniques using matplotlib.

CO3: perform univariate data analytics

CO4: apply data exploration techniques for bivariate data.

CO5: apply data exploration techniques for multivariate data and time series data.

CO1: explore the fundamentals of exploratory data analysis.

EDA fundamentals – Describing data science – Significance of EDA – Making sense of data –Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques. **L:9**

CO2: implement the data visualization techniques using matplotlib.

Data Visualization: Introduction to Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn **L:9**

CO3: perform univariate data analytics.

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread – Scaling and Standardizing – Inequality. **L:9**

CO4: apply data exploration techniques for bivariate data.

Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables –Handling Several Batches – Scatterplots and Resistant Lines. **L:9**

CO5: apply data exploration techniques for multivariate data and time series data.

Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA –Characteristics of time series data – Data Cleaning – Time-based indexing –Visualizing–Grouping – Resampling. **L:9**

TEXT BOOKS

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with python", Packt Publishing, 2020.
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", 2nd Edition, O'Reilly, 2022.

REFERENCES

1. Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008.
2. Eric Pimpler, "Data Visualization and Exploration with R, Geo Spatial Training service", 2017.
3. Mike Kahn, "Data Exploration and Preparation with Big Query", 1st Edition, Packt Publishing, 2023

L:45; TOTAL:45PERIODS

Course Code		**L**	**T**	**P**	**E**	**C**
23AD43C	**COMPUTER NETWORKS**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the students will be able to

Theory Component

CO1: Analyze the functionalities of various layers and network components

CO2: Evaluate various access control mechanisms for error free data communication.

CO3: Apply various flow, congestion control and routing algorithms for effective transmission of data.

CO4: Apply transport layer protocols and identify congestions among transmission.

CO5: Demonstrate various application layer protocols to enhance the internet applications and other networks.

CO1:Analyze the functionalities of various layers and network components **L:9**

Introduction - Network Edge and Core - Network OS - Modes of operations - Layering and Protocols - OSI Reference Model - TCP/IP Protocol suite - Network Topologies – Internet Architecture - Physical Layer: Signal Characteristics - Transmission media - Signal Encoding Techniques-Performance Metrics-Case study: Configuring of network topology using network simulation.

CO2: Evaluate various access control mechanisms for error free data communication. **L:10**

Data Link layer-Link-Layer Addressing–Design issues-Error detection and Correction-Data Link Layer Protocols-HDLC-PPP–Sliding window protocols-Media Access Control –Multiple access protocols-CSMA/CD-CSMA/CA-Wired LANs: Ethernet-Ethernet bridging- Wireless LANs–Broadband Wireless- Bluetooth-RFID-Virtual LAN-Case Study on Error detection and Correction.

CO3:Apply various flow, congestion control and routing algorithms for effective transmission of data **L:9**

Network Layer : Design issues– Routing algorithms – Congestion control algorithms– Quality of service-Switching : Circuit Switching – Packet Switching-IPV4 & IPV6 Addresses – Internetworking - OSPF-IGP-BGP-mobile IP-Case study on Routing algorithms.

CO4: Apply transport layer protocols and identify congestions among transmission. **L:9**

Transport layer: Transport Service - Elements of transport protocols - Congestion control –Internet Transport protocols-UDP–TCP –Reliable Byte Stream-Connection Management- Flow Control - Error Control - Congestion Control - Congestion avoidance (DECbit, RED) – Performance issues – Case study: Implementation of TCP and UDP using simulation tools.

CO5: Demonstrate various application layer protocols to enhance the internet applications and other networks. **L:8**

Application layer: Role of proxy - DNS - Electronic mail (SMTP - POP3 - IMAP) – World Wide Web-HTTP-FTP –Streaming audio and video-DASH-Content Delivery-Telnet SSH – Case Study on Unicast protocol for finding shortest path in chat application.

TEXTBOOKS

1. Andrew S Tanenbaum, David J Wetherall, “Computer Networks”, Prentice Hall of India, Pearson Education, 6th Edition, 2021.
2. James F Kurose, Keith W Ross, "Computer Networking-A Top-Down Approach Featuring the Internet", Pearson Education, 8th Edition, 2021.

REFERENCES

1. Behrouz A.Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, TMH, 6th Edition, 2022.
2. JillWest, “Comp TIA Network + Guide to Networks”, Cengage Learning, 9th Edition, 2021.
3. Larry L Peterson, Bruce S Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers, 6th Edition, 2021.

L:45;TOTAL:45PERIODS

Course Code	MACHINE LEARNING	L	T	P	E	C
23AD44C		3	0	2	0	4

COURSE OUTCOMES

Upon completion of the course, students will be able to:

Theory Component

CO1:relate the basic concepts of mathematics for machine learning models to solve the problems.

CO2: analyze various techniques of supervised learning to build the classifiers

CO3: adopt the unsupervised algorithms for clustering process.

CO4: adopt the dimensionality reduction techniques for both supervised and unsupervised learning.

CO5: analyze probabilistic graphical models to resolve uncertainties.

Practical Component

CO6: implement the concepts of hypothesis space algorithm for suitable application.

CO7: demonstrate the performance of different ML algorithms using supervised learning and unsupervised learning.

CO8: develop various classification algorithms and graph based learning algorithms for solving real time applications.

CO1: relate the basic concepts of mathematics for machine learning models to solve the problems.

Introduction to Machine Learning– Convex set – Convex function – Unconstrained Convex Optimization- Gradient Ascent/Descent- Loss functions in ML - Version Space - Hypothesis spaces. **L:7;P:4**

CO6: implement the concepts of hypothesis space algorithm for suitable application.

Implementation of Hypothesis spaces using Find-S algorithm and Candidate Elimination algorithm.

CO2: analyze various techniques of supervised learning to build the classifiers

Supervised learning: Regression- Introduction - Linear Regression - Logistic Regression- Locally weighted regression - Classification: Support Vector Machines - Kernel Methods- Vapnik - Chervonenkis Dimension - Decision Tree using ID3 - Classification and regression trees (CART) – Probabilistic generative model: Naïve Bayes Classifier -Random Forests – Ensemble methods. **L:10;P:6**

CO7: demonstrate the performance of different ML algorithms using supervised learning and unsupervised learning. (PDL2)

Solve the real time application using non-parametric Locally Weighted Regression algorithm, Implementation of SVM; Demonstrate the decision tree ID3 algorithm.

CO3: adopt the unsupervised algorithms for clustering process.(CDL2)

Unsupervised learning: Clustering-Introduction- K-means- Partitional Clustering, Hierarchical Clustering, Density-based clustering algorithms, Grid based clustering approach – Probability model based methods: Fuzzy Clustering, Expectation Maximization Algorithm – Constraint based clustering – Outlier analysis. **L:10; P:6**

CO7: demonstrate the performance of different ML algorithms using supervised learning and unsupervised learning. (PDL2)

Apply k-Means algorithm to clusters for a dataset, Build a Fuzzy C-Means algorithm.

CO4:adopt the dimensionality reduction techniques for both supervised and unsupervised learning

Dimensionality Reduction: Introduction – Principal Component Analysis – Linear Discriminant Analysis – Singular Value Decomposition – Feature Selection Techniques: Filter Methods: Chi Square Test, ANOVA- Wrapper Methods: Recursive Feature Elimination - Embedded Methods: Lasso, Elastic Net – Comparative analysis of feature selection methods. **L:9; P:6**

CO7: demonstrate the performance of different ML algorithms using supervised learning and unsupervised learning.(PDL1)

Develop PCA to reduce the dimensionality of the data for image dataset, Implement the suitable dimensionality reduction technique, Apply the dimensionality reduction techniques.

CO5: analyze probabilistic graphical models to resolve uncertainties. (CDL2)

Graphical Models: Introduction-Bayesian Belief Network: Constructing BBN- Bayesian Inference: Markov Chain: Markov Random Fields – **Hidden Markov Model:** Computing Likelihood Probability – Decoding Problem- Baum-Welch Algorithm. **L:9;P:8**

CO8: develop various classification algorithms and graph based learning algorithms for solving real time applications. (PDL2)

Implement a Bayesian Inference; Demonstrate a Sequential Network Attack using Hidden Markov Model- Mini project on real time applications of machine learning using python.

TEXT BOOKS

1. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, 4th Edition, 2020.
2. S Sridhar, M Vijayalakshmi, “Machine Learning”, Oxford University Press India, 1st Edition, 2021.

3. Christopher M. Bishop, "Pattern Recognition And Machine Learning" Paperback , 2016
4. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", CRC Press, 2nd Edition, 2014.

REFERENCES

1. Pradhan, Manaranjan, and U.Dinesh Kumar, "Machine Learning Using Python", Wiley, 1st Edition, 2020.
2. Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packet publishing, 3rd Edition, 2019.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2nd Edition, 2018.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 1st Edition, 2017.

L:45; P:30; TOTAL:75 PERIODS

Course Code	DATABASE MANAGEMENT SYSTEMS	L	T	P	E	C
23AD45C	*(Common to CSE, IT and AI&DS Degree Programmes)*	3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components:

CO1:design ER model and apply the SQL concepts to perform various operations in a relational database

CO2: apply normalization concept to remodel the database and maintain consistency with suitable transaction management.

CO3: apply the intermediate query concept to retrieve data from multiple relations.

CO4: apply PL/SQL constructs to enhance the database activities and develop application using database connectivity drivers.

CO5: apply the query evaluation plan and optimize the query to reduce complexity.

Practical Components:

CO6: demonstrate database normalization using appropriate tool for enhancing data integrity

CO7: design and implement SQL queries for data manipulation.

CO8: build applications using database connectivity drivers and implement programming concepts using PL/SQL constructs.

CO9: demonstrate indexing and partitioning concepts using Common Table Expression.

CO1: design ER model and apply the SQL concepts to perform various operations in a relational database

CO2: apply normalization concept to remodel the database and maintain consistency with suitable transaction management.

CO6: demonstrate database normalization using appropriate tool for enhancing data integrity **L:19; P:8**

Introduction to Database System-Views of data - Database System Architecture – ER Models – Enhanced-ER Model - Relational Model- ER-to-Relational Mapping. SQL: Keys - DDL Statements - DML Statements – DCL & TCL Statements - SQL Aggregate Functions.

Functional Dependencies –Non loss Decomposition–Normalization: First, Second, Third Normal Forms, Dependency Preservation –Boyce/Codd Normal Form. Denormalization Techniques: Horizontal, Vertical and Mixed. Transaction: Basic Concepts -Transaction

Recovery –ACID Properties - Concurrency – Deadlock Develop Database Design using ER Diagram and Perform Database Manipulations operations using DDL, DML, TCL and DCL commands. Perform normalization for the given schema using appropriate tool.

CO3: apply the intermediate query concept to retrieve data from multiple relations **L:8**
CO7: design and implement SQL queries for data manipulation **P:7**

SQL Clauses - Group By – Having - Sub Query – Nested Sub Query -Null Functions – Indexes - Sequences – SQL Joins - Types – Views - SQL Injections - SQL Window functions -Types: Aggregate- Value- Ranking Writing SQL Queries to retrieve data from multiple relations.

CO4: implement PL/SQL constructs to enhance the database activities and develop application using database connectivity drivers. **L:9 P:10**
CO8: build applications using database connectivity drivers and implement programming concepts using PL/SQL constructs.

PL/SQL Introduction - Control statements –Procedures - Functions – Cursors – Triggers – Exceptions – Embedded SQL - ODBC Connectivity- Case Study: CRUD operations in Industry specific application.

Develop PL/SQL Programs to demonstrate the concept of Control statements –Procedures - Functions – Cursors – Triggers – Exceptions.

Develop application to perform CRUD operations using ODBC connectivity.

CO5: apply the query evaluation plan and optimize the query to reduce complexity. **L:9**
CO9: demonstrate indexing and partitioning concepts using Common Table Expression. **P:5**

Query Processing: Parsing and Translation, Optimization, Evaluation; Measures of Query Cost. Query Optimization: Query Evaluation Plan (QEP), cost based query optimization, Estimation of QEP cost. Indexing concepts– CTE– Partitioning.

Create indexing and implement partitioning concepts using Common Table Expression (CTE) for the given schema.

TEXT BOOKS

1. Silberschatz, A, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 7th Edition, Tata McGraw Hill, 2019.
2. David M. Kroenke, David J. Auer, Scott L. Vandenberg, Robert C. Yoder, "Database Concepts", 9th Edition, Pearson Education, 2020.

REFERENCE BOOKS

1. RamezElmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson / Addision wesley, 2019.
2. Wilfried Lemahieu, KU Leuven, Belgium Seppevanden Broucke, KU Leuven, Belgium Bart Baesens, KU Leuven, Belgium, "Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data",2018
3. C.J.Date, A. Kannan and S.Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.

WEB REFERENCES

"Introduction to Database Systems" -NPTEL Course.

L:45; P:30; TOTAL: 75 PERIODS

Course Code	FUNDAMENTALS OF DATA SCIENCE AND	L	T	P	E	C
23AD46C	ANALYTICS	2	0	2	2	4

COURSE OUTCOMES

Upon the successful completion of the course, the students will be able to

Theory Component

CO1:explore the fundamentals of data science

CO2:utilizethe python libraries like Numpy and pandas for data wrangling

CO3: apply descriptive analytics concepts to analyze statistical measures and visualize the data

CO4: implement inferential analytics for performing statistical inferences of the data.

CO5: analyze the variances in the data using ANOVA

Practical Component

CO6: develop python programs to implement data manipulation concepts using Numpy and Pandas

CO7:demonstrate descriptive analytics concepts and data exploration for a real time dataset

CO8: perform inferential data analytics and analyze variance for identifying the distribution of dynamic data

Experiential Component

CO9: create expert solutions for solving real time data science applications

Soft skill Component

CO10:demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation process

CO1:explore the fundamentals of data science

Introduction to Data Science: Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data–exploratory data analysis–build the models–presenting and building applications **L:6**

CO2:utilize the python libraries like numpy and pandas for data wrangling

Python libraries for data wrangling: Basics of Numpy arrays – aggregations – computations on arrays – fancy indexing –structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – Data visualization using Matplotlib **L:6**

CO6: develop python programs to implement data manipulation concepts using Numpy and Pandas **P:6**

E:6

Working with Numpy arrays –Working with Pandas for data manipulation operations-Basic plots using Matplotlib

CO3:apply descriptive analytics concepts to analyse statistical measures and visualize the data

Descriptive Analytics : Frequency distributions – Outliers –interpreting distributions – graphs –averages – describing variability–inter quartile range –variability for qualitative and ranked data – Normal distributions–z scores–correlation–scatter plots–regression – standard error of estimate – multiple regression **L:6;**

P:8

E:6

CO7:demonstrate descriptive analytics concepts and data exploration for are altime data set

Perform analytics using Frequency distributions, Averages, Variability, Development of normal curves, Correlation and scatter plots

CO4: implement inferential analytics for performing statistical inferences of the data.

Inferential Statistics : Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – effect of sample size. **L:6, P:6 E:8**

CO8: perform inferential data analytics and analyze variance for identifying the distribution of dynamic data

Working with Z-test, Demonstration of T-test

CO5:analyze the variances in the data using ANOVA

Analysis of variance: t-test for one sample – sampling distribution of t –t-test for two independent samples –p-value. F-test – ANOVA – Two factor experiments – Chi-square tests

CO8: perform inferential data analytics and analyze variance for identifying the distribution of dynamic data **L:6 P:10 E:10**

Working with ANOVA - Building and validating linear models and logistic models

CO10:demonstrate the ability to collaborate with peers, leveraging diverse perspectives to enhance the ideation process

Develop and demonstration of mini project.

TEXTBOOKS:

1. Jake Vander Plas, "Python Data Science Handbook", 2nd Edition, O'Reilly, 2022.

REFERENCES:

1. David Cielen, Arno D.B.Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, "Statistics", 11th Edition, Wiley Publications, 2017.
3. SanjeevJ.Wagh, Manisha S.Bhende, Anuradha D.Thakare, "Fundamentals of Data Science", CRC Press, 2022.
4. Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", A press, 2021.
5. Chirag Shah, "A Hands-on Introduction to Data Science", Cambridge University Press, 2020.

L:30;P:30; E:30; TOTAL: 90PERIODS

Course Code	MODELING PROJECTS	L	T	P	E	C
23AD47C	*(Common to CSE, IT & AIDS Degree Programmes)*	**0**	**0**	**2**	**2**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Practical Component:

CO1:apply different methods to translate the approaches for solving problems into robust computational models. (PDL3)

CO2: validate the model in end user's perspectives and adopt the implications to summarize the optimal method for solving the problem (CDL3)

CO3: explore and synthesize system requirements from larger social and professional concerns and able to develop software requirement specifications (CDL3)

Experiential Component:

CO4: develop, calibrate and demonstrate a prototype model and eventually present model findings in a way that is appealing to real world (PDL3)

Soft Skill Component

CO5: organize efficient and effective communication with the peers and engage in the modeling project with a high degree of independence and responsibility to exhibiting team work

CO1: apply different methods to translate the approaches for solving problems into robust computational models

The goal of the Modelling project is to learn principles and methodologies of project prototype development in a real-world context with a project team of 2 to 3 students. Some teams will have the opportunity to work with students from multiple disciplines. **P:8**

- Task 01: Reframe / Refine the idea proposed during design thinking practice or identify new problem and prepare a one page project proposal
- Task 02: Proposal Presentation and review - I

CO2: validate the model in end user's perspectives and adopt the implications to summarize the optimal method for solving the problem

- Task 03: Translating customer and user needs information into specifications
- Task 04: Project Proposal and Specifications.
  A written proposal including background information and objectives to be submit. It will be evaluated on content, completeness, and clarity. **P:7**

CO3:explore and synthesize system requirements from larger social and professional concerns and able to develop software requirement specifications

- Task 05: Review – II (Project Proposal)
- Task 06: Systems Requirements **P:7**

CO4:develop, calibrate and demonstrate a prototype model and eventually present model findings in a way that is appealing to real world

- Task 07: Review – III (System Requirements)
- Task 08: Prototype Design
  - User Interface Design
  - Conversion Strategy **E:30**
- Task 09: Review – IV (Prototype Design)
- Task 10: Project Document Submission

P:30; E:30; TOTAL:60 PERIODS

Course Code		L	T	P	E	C
23GN04C	**APTITUDE EXCELLENCE**	**0**	**0**	**2**	**0**	**1**

COURSE OUTCOMES

Upon the completion of the course the students will be able to

CO1: Infer appropriate methods to simplify computation

CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability

CO3: Interpret fundamentals in quantitative techniques and solve problems quickly

CO4: Improve quantitative skills and solve problems on permutation and Combination

CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

CO1: Infer appropriate methods to simplify computation

Simplification: Nested Series simplification(fraction) -BODMAS rule – Viraculum (or Bar) rule – Modulus of a real number –Multiplication shortcuts -Comparing Fractions-Data Sufficiency **P:6**

CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability

Time and Work: Work Done - Days from Work:- Ratio – Efficiency –Work and wages - Data Sufficiency **P:6**

CO3: Interpret fundamentals in quantitative techniques and solve problems quickly

Time Speed Distance: Body moving in the same direction- Body moving in the opposite direction-Average speed- Meeting point - Data Sufficiency **P:6**

CO4: Improve quantitative skills and solve problems on permutation and Combination

Probability Permutation Combination: Fundamental Counting Principle – Computing Permutation – Circular Permutation – Computing Combinations - Data Sufficiency **P:6**

CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

Abstract reasoning: Mirror and water image – Figure Matrix –Pattern Completion – Logical puzzles – Dot situation - Ranking ordering. **Cognitive ability:** Blood Relation - Direction Sense Test-Data Sufficiency **P:6**

REFERENCE BOOKS

1. R.V.Praveen, "Quantitative Aptitude and Reasoning" , 3rd Edition , Eastern Economy Edition, PHI Learning 2016
2. Arun Sharma," Quantitative Aptitude for CAT", McGraw Hill Edge, 10th Edition 2022
3. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition 2017

P:30; TOTAL: 30 PERIODS

Course Code	LINEAR ALGEBRA, MATHEMATICAL LOGIC AND SET THEORY	L	T	P	E	C
23SH01E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: analyze concepts of vector spaces. (CDL 1)

CO2: measure the similarity between different datasets using Inner product spaces. (CDL 1)

CO3: decompose the matrix for computational convenience. (CDL 1)

CO4: illustrate the validity of the arguments. (CDL 1)

CO5**:** analyze the concepts of Sets, Relations and Functions. (CDL 1)

CO1: analyze concepts of vector spaces

Vector spaces – Subspaces – Linear combinations – linear span - Linear independence and linear dependence – Bases and dimensions. **L:6 T:3**

CO2: measure the similarity between different datasets using Inner product spaces

Linear transformation - Null spaces and ranges – Rank Nullity theorem - Matrix representation of a linear transformations - Inner product space - Norms - Orthonormal Vectors - Gram Schmidt orthogonalisation process**.** **L:6 T:3**

CO3: decompose the matrix for computational convenience

Generalized eigenvector - QR decomposition- generalized inverse - Singular value decomposition and applications – Pseudo Inverse . **L:6 T:3**

CO4: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Predicate Calculus and Quantifiers - Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO5: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Partial Ordering Relation - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions. **L:6 T:3**

TEXT BOOKS

1. Kenneth H.Rosen, Discrete Mathematics and its Applications (with Combinatory and Graph Theory), Special Indian Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 8th Edition, 2021.
2. Bernard Kolman and David Hill, "Elementary Linear Algebra with Application" Pearson India, 9th Edition, 2019.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

REFERENCE BOOKS

1. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi,2017.
2. Friedberg, A.H., I nsel,A.J.and Spence, L., Elementary Linear Algebra, a matrix approach, 2nd Edition pearson Publication.
3. Raju.K.George and Abhijith Ajayakumar, A course in Linear Algebra, Springer, 2024.
4. Seymour Lipschutz Marc Lipson., "Linear Algebra" Schaum's Out lines series, 6th Edition, McGraw – Hill Education, 2018.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	LINEAR STRUCTURES AND	L	T	P	E	C
23SH02E	TRANSFORMATIONS	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: solve the linear system of equations. (CDL 1)

CO2: determine the dimension of vector spaces. (CDL 1)

CO3: find the orthonormal vectors using Inner product spaces. (CDL 1)

CO4: illustrate Jordan canonical form on a finite dimensional vector space. (CDL 1)

CO5:decompose the matrix using Generalized Eigen vectors for computation.(CDL 1)

CO 1: solve the linear system of equations **L:6**

General system of linear equations – Matrices– Echelon form of matrix- Solving linear systems- Consistency of a system of linear equations -LU factorization. **T:3**

CO2: determine the dimension of vector spaces

Vector spaces – Subspaces – Linear combinations – linear span - Linear independence and linear dependence – Bases and dimensions. **L:6 T:3**

CO3: find the orthonormal vectors using Inner product spaces

Linear transformation - Null spaces and ranges – Rank Nullity Theorem - Matrix representation of a lineartransformations - Inner product space - Norms - Orthonormal Vectors - Gram Schmidt orthogonalisation process. **L:6 T:3**

CO4: illustrate Jordan canonical form on a finite dimensional vector space

Generalized eigenvector- Chains- Canonical basis the minimum polynomial- - Algebraic and Geometric multiplicity of Eigen Values - Similar matrices-Modal matrix-Jordan canonical form. **L:6 T:3**

CO5: decompose the matrix using Generalized Eigen vectors for computation

Eigen-values using QR transformations – Generalized Inverse Eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse **L:6 T:3**

TEXT BOOKS

1. Bernard Kolman and David Hill, “Elementary Linear Algebra with Application” Pearson India, 9th Edition 2019.
2. Seymour Lipschutz Marc Lipson., “Linear Algebra” Schaum’s Out lines series, Six edition, McGraw – Hill Education, 2018.

REFERENCE BOOKS

1. Friedberg, A.H., I nsel,A.J.and Spence, L., Elementary Linear Algebra, A Matrix Approach, 2nd Edition, Pearson 2019.
2. Jim Defranza. Daniel Gagiardi “Introduction to Linear Algebra with Applications” Waveland Pr Lnk, 2015.
3. Eggar.Goodaire “Linear Algebra Pure & Applied”, World Sceintific, New Delhi, first edition, 2015.
4. Raju.K.George and Abhijith Ajayakumar, A course in Linear Algebra, Springer, 2024.

L : 30; T :15; TOTAL : 45 PERIODS

1. Course Code		L	T	P	E	C
23SH03E	NUMBER THEORY	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: acquire the concepts of theory of numbers. (CDL 1)

CO2: apply the fundamental propositions to interpret solutions of congruence. (CDL 1)

CO3: find the primitive roots for the congruence. (CDL 1)

CO4: analyze the inter-relation between arithmetical functions. (CDL 1)

CO5: determine quadratic residues of congruence. (CDL 1)

CO1 : acquire the concepts of theory of numbers

Introduction – Divisibility- Greatest common divisor - Prime numbers - The fundamental theorem of arithmetic - The series of reciprocals of the primes - The Euclidean algorithm(without Proof) - The greatest common divisor of more than two numbers. **L:6 T:3**

CO2 : apply the fundamental propositions to interpret solutions of congruence

Congruence - Linear congruence - Euler-Fermat theorem - Polynomial congruence modulo p – Wilson's Theorem **L:6 T:3**

CO3: analyze the inter-relation between arithmetical functions.

The Mobius function μ(n) – The Euler Totient function φ(n)– A relation connecting φ and μ – A product formula for φ(n) – properties of φ(n) –Multiplicative functions– completely multiplicative function. **L:6 T:3**

CO4: determine quadratic residues of congruence

Quadratic Residues – Legendre's symbol and its properties – Evaluation of (-1|p) and (2|p) – Gauss lemma – The Quadratic Reciprocity law – Applications – The Jacobi symbol. **L:6 T:3**

CO5: implement the concepts of congruence in cryptography

Chinese remainder theorem - Applications of Chinese remainder theorem - Cryptography and its application – RSA algorithm and Rabin Cryptosystem. **L:6 T:3**

TEXT BOOKS

1. Tom M.Apostol, "Introduction to Analytic Number Theory", Springer International Edition, Narosa Publishing House, New Delhi, 2013.
2. G.A.Jones & J.M.Jones, "Elementary Number Theory", Springer publications, 2012.

REFERENCE BOOKS

1. David M.Burton, "Elementary Number Theory", McGraw Hill, 7th Edition,2023
2. Joseph H.Silverman, "A Friendly Introduction to Number Theory", Pearson Education, 4th Edition, 2019.
3. Titu Andreesu, Gabriel Dospinescu, Oleg MushKarov, Number Theory: concepts and problems, Springer Science & Business Media, 2017.
4. S B Malik , "Basic Number Theory", S Chand publications, 2nd Edition, 2018

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	NUMERICAL ANALYSIS	L	T	P	E	C
23SH04E		2	1	0	0	3

COURSE OUTCOMES:

Uponcompletionofthiscourse,thestudentwillbeableto

CO1: solve algebraic and transcendental equations using numerical methods. (CDL 1)

CO2: interpolate and approximate the polynomial of data. (CDL 1)

CO3: perform numerical differentiation and integration. (CDL 1)

CO4: find numerical solution of ordinary differential equation. (CDL 1)

CO5: classify and find numerical solution of partial differential equations. (CDL 1)

CO 1: solve algebraic and transcendental equations using numerical methods

Solutions of Algebraic linear equations Newton - Raphson Method, Fixed Point Iteration method - Solutions of algebraic simultaneous linear equations - Gauss Elimination –Gauss Seidel Methods. **L:6 T:3**

CO 2: interpolate and approximate the polynomial of data

Curve Fitting – Method of Least Squares – Fitting a Straight Line – Fitting a Second Degree Parabola - Finite differences - Newton's Forward & Backward Difference Formulae - Central Differences - Stirling's Formula - Lagrange's Formula. **L:6 T:3**

CO 3: perform numerical differentiation and integration

Derivatives using forward and backward difference Formulae - Trapezoidal rule - Simpson's rules - Double integration using Trapezoidal and Simpson's rules. **L:6 T:3**

CO 4: find numerical solution of ordinary differential equation

Taylor's Series Method - Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods - Milne's Method - Finite difference for solving ordinary differential equation. **L:6 T:3**

CO 5: classify and find numerical solution of partial differential equations

Classification of Partial Differential Equations of second order - Finite difference solution of one dimensional heat equation by explicit and implicit methods (Crank Nichelson and Bender Schmidth methods) - One dimensional wave equation and two dimensional Laplace and Poisson equations. **L:6 T:3**

TEXT BOOKS

1. Grewal, B.S., "Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB", 11th Edition, Khanna Publishers, New Delhi, 2014.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain "Numerical Methods for scientific and Engineering Computation", 6th Edition, New age International Publishers, 2019.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, J. Wiley and Sons, 2023.

REFERENCE BOOKS

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 8th Edition, Tata McGrawHill, New Delhi, 2021.
2. Saumyen Guha, Rajesh Srivastava "Numerical Methods: For Engineering and Science", Oxford University Press, New Delhi, 1st Edition with third impression, 2015.
3. K.Sankara Rao , "Numerical Methods For Scientists And Engineers", 5th Edition, New age International Publisher, 2018
4. Dr Chaitanya Kumar, Dr Harinderjit Kaur Chawla, Dr Indarpal Singh "A Textbook on Numerical Methods and Analysis" Sultan Chand and SonsPublisher, 2024

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH05E	**OPTIMIZATION TECHNIQUES**	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: find optimum solution of linear programming problem. (CDL 1)

CO2: determine the optimum schedule for assignment and transportation problems. (CDL 1)

CO3: acquire decision making in Pure and Mixed Strategies. (CDL 1)

CO4: analyze the network for optimal schedule. (CDL 1)

CO5: compute optimum solution of non-linear programming. (CDL 1)

CO1: find optimum solution of linear programming problem

Linear Programming Problem – Mathematical Formulation of Linear Programming Problems (LPP) – Graphical Solution Method - Canonical and Standard Forms of LPP - Simplex Method - Linear Programming using Artificial Variables - Two Phase Method. **L:6 T:3**

CO2:acquire decision making in Pure and Mixed Strategies

Basic Terms in Game Theory - Two-Person Zero-Sum Games - Maximin-Minimax Principal - Games without Saddle Points - Mixed Strategies-Pure and Mixed Strategies with Saddle Point- Mixed Strategy Problems by Arithmetic Method- Graphic Solution of $2 \times n$ and $m \times 2$ Games. **L:6 T:3**

CO3: analyze the network for optimal schedule

Development of Network Analysis - Network Analysis and Rules of Network Construction - Critical Path Method (CPM) - Programme Evaluation and Review Technique (PERT). **L:6 T:3**

CO4: compute optimum solution of non – linear programming

Formulating a Non-Linear Programming Problem – Constrained Optimization with equality Constraints- Graphical Solution – Kuhn- Tucker Conditions with Non negative constraints- Quadratic Programming – Wolfe's modified Simplex method. **L:6 T:3**

CO5: solve non-linear constrained optimization

Optimization using Gradient Descent – Constrained optimization - Lagrange Multipliers - Convex optimization - Non linear Constrained Optimization. **L:6 T:3**

TEXT BOOKS

1. KantiSwarup, Gupta P.K and Man Mohan, Operations Research: Introduction to management Science, Sultan Chand &Sons, 20th Revised Edition, 2022.
2. Hamdy A Taha, Operations Research - An Introduction, 10th Edition, Pearson Education, 2019.

REFERENCE BOOKS

1. Sharma JK., Operations Research, Trinity, New Delhi, 6th Edition, 2017.
2. Sundaresan.V, Ganapathy Subramanian. K.S. and Ganesan.K, Resource Management Techniques, A.R. Publications, 11th Edition, 2017.
3. Gupta P K, Mohan Man, Problems in Operations Research, Sultan Chand & Sons, 2014
4. V K Kapoor, Operations Research , Concept problems & solutions, Sultan Chand & Sons, 2017

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH06E	**PRINCIPLES OF DISCRETE MATHEMATICS**	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: illustrate the validity of the arguments. (CDL 1)
CO2: analyze the concepts of Sets, Relations and Functions. (CDL 1)
CO3: perform the principles of counting and solve recurrence relations. (CDL 1)
CO4: interpret the basic concepts of graphs. (CDL 1)
CO5: compute minimum Spanning Trees and shortest route for the graph. (CDL 1)

CO1: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO2: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions. **L:6 T:3**

CO3: perform the principles of counting and solve recurrence relations.

Mathematical induction - Strong induction and well ordering -The basics of counting – The pigeonhole principle - Recurrence relations – Solving linear recurrence relations – Generating functions - Inclusion and exclusion principle. **L:6 T:3**

CO4:interpret the basic concepts of graphs

Graphs and their properties - Special types of graphs – Matrix representation of graphs and graph isomorphism- Euler and Hamiltonian graphs. **L:6 T:3**

CO5: compute minimum Spanning Trees and shortest route for the graph

Trees – Some properties of Trees – Pendant vertices in a Tree – Distance and centers in a Tree – Rooted and Binary Trees - Spanning Trees- minimum spanning tree–Prim's algorithm. **L:6 T:3**

TEXT BOOKS

1. Kenneth H.Rosen, Discrete Mathematics and its Applications (with Combinatory and Graph Theory), Special Indian Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 8th Edition, 2021.
2. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, first Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2020.
3. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, 1st Edition, Dover Publications Inc., 2016.

REFERENCE BOOKS

1. Ralph .P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson Education Asia, Delhi, 2019.
2. Bondy, J.A., Murty.U.S.R., Graph Theory with applications, North Holland publication, 2008.
3. K.Balakrishnan, Schaum's Outline of Graph Theory, Tata Mc Graw-Hill Pub, 2020.
4. Richard J.J, Introduction to Graph Theory, 1st Edition, Parker Pub. Company, 2017.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	**RANDOM PROCESSES AND QUEUEING THEORY**	**L**	**T**	**P**	**E**	**C**
23SH07E		**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: interpret the basic characteristic features of Random processes. (CDL 1)

CO2: encapsulate the time averages of uncertain events. (CDL 1)

CO3: evaluate spectral densities of functions. (CDL 1)

CO4: analyze the characteristics of Markovian queues. (CDL 1)

CO5**:**apply the concepts of queuing theory in networks.(CDL 1)

CO1: interpret the basic characteristic features of Random processes **L:6 T:3**

Classification - Stationary process - Markov process - Markov chains - Transition probabilities.

CO2 : encapsulate the time averages of uncertain events **L:6 T:3**

Counting Process - Ergodic process - Poisson Process - Renewal Processes - Gaussian process.

CO3 :evaluate spectral densities of functions **L:6 T:3**

Auto correlation - Cross correlation – Power spectral density–Cross spectral density-Properties–Wiener – Khintchine theorem (without proof).

CO4 : analyze the characteristics of Markovian queues **L:6 T:3**

Markovian models – Birth and Death Queuing models- Steady state results: Single and multiple server queuing models- queues with finite waiting rooms- Finite source models- Little's Formula.

CO5: apply the concepts of queuing theory in networks **L:6 T:3**

M/G/1 queue- Pollaczek- Khintchine formula, series queues- open and closed networks.

TEXT BOOKS

1. Oliver C. Ibe, "Fundamentals of Applied Probability and Random processes", Academic Press, 2nd Edition, 2014.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes, Tata McGraw-Hill Education, 3rdEdition, 2017.
3. John F Shortle, James M Thompson, Donald Gross and Carl M Harris, "Fundamentals of Queueing Theory", Wiley and Sons Publication Limited, 5thEdition, 2018.

REFERENCE BOOKS

1. Miller.S.L and Childers, S.L, Probability and Random Processes with applications to Signal Processing and Communications, Elsevier Inc., 2nd Edition, 2012.
2. Peyton. Z. Peebles Jr., Probability Random Variables and Random Signal Principles, 4th Edition, Tata McGraw-Hill Publishers, New Delhi, 2017.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	STATISTICAL TECHNIQUES AND NUMERICAL METHODS	L	T	P	E	C
23SH08E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: calculate the various measures of dispersion. (CDL 1)
CO2: apply the principles of hypothesis testing in small and large samples. (CDL 1)
CO3: analyze the variances in design of experiments. (CDL 1)
CO4: find solution of linear equations and to perform differentiation and integration numerically. (CDL 1)
CO5: compute numerical solution of differential equations. (CDL 1)

CO1: calculate the various measures of dispersion

Central tendencies - Mean, median, mode - Measures of Dispersion –Mean deviation, and Quartile deviation–Moments– Skewness –Kurtosis - Correlation and Regression. **L:6 T:3**

CO2: apply the principles of hypothesis testing in small and large samples

Sampling distributions - Statistical hypothesis - Large sample testsbased on Normal distribution for single mean and difference of means -Tests based on t, and F distributions - Chi-square -Contingency table for independent of attributes – Goodness of fit. **L:6 T:3**

CO3: analyze the variances in design of experiments

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design. **L:6 T:3**

CO4: find solution of linear equations and to perform differentiation and integration numerically

Solution of algebraic and transcendental linear equations - Newton - Raphson Method- Solution of simultaneous equations – Gauss Elimination method – Gauss Seidel method – Interpolation – Lagrange's Method - Numerical Differentiation – Newton's forward difference and backward difference formula – Numerical integration - Single integration using Trapezoidal and Simpson's 1/3 rd and 3/8 th rules. **L:6 T:3**

CO5: compute numerical solution of differential equations

Taylor's Series Method – Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods – Milne's Method - Solution of one dimensional heat equation by explicit and implicit methods(Crank Nichelson and Bender Schmidth methods) - Two dimensional Laplace and Poisson equations. **L:6 T:3**

TEXT BOOKS

1. Richard A. Johnson, "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education Private Ltd., 2018.
2. Grewal, B.S., "Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB", 11thEdition, Khanna Publishers, New Delhi, 2014.

REFERENCE BOOKS

1. Dharmaraja Selvamuthu , Dipayan Das, Introduction to Statistical Methods, Design of Experiments and Statistical Quality Control, Springer Verleg Singapore Pvt. Ltd., 2018.
2. S.C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand & Sons, Delhi, 2014.
3. M.K.Jain.S.R.K.Iyengar,R.K.Jain "Numerical Methods for scientific and Engineering Computation", 6th Edition, New age International Publishers, 2019.
4. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 8th Edition, Tata McGraw - Hill, New Delhi, 2021.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	TRANSFORMS, MATHEMATICAL LOGIC AND SET	L	T	P	E	C
23SH09E	THEORY	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

Theory Components:

CO1: apply Laplace transform to solve ordinary differential equations. (CDL 1)

CO2: compute the Fourier transforms of various functions. (CDL 1)

CO3: solve difference equations using Z-Transform. (CDL 1)

CO4: illustrate the validity of the arguments. (CDL 1)

CO5**:** analyze the concepts of Sets, Relations and Functions. (CDL 1)

CO 1 : apply Laplace transform to solve ordinary differential equations

Definition of Laplace transform and its inverse – Transforms of elementary functions – Properties – Transforms of periodic functions – Initial and final value theorems – Convolution theorem.- solutions of linear ordinary differential equations with constant coefficients. **L:6 T:3**

CO2 : compute the Fourier transforms of various functions

Fourier Integral theorem (without proof)–Fourier transform pair–Fourier Sine and Cosine transforms–Properties–Transforms of simple functions–Convolution theorem –Parseval's theorem. **L:6 T:3**

CO3 : solve difference equations using Z-Transform

Z– transform –Elementary properties – Inverse Z–transform – Convolution theorem- Initial and final value theorem – Formation of difference equations –Solutions of difference equations using Z–transform. **L:6 T:3**

CO4: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO5: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions **L:6 T:3**

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2021.
2. Kenneth H.Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill Publishing Company Limited, New Delhi, 8th Edition, 2021.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

REFERENCE BOOKS

1. Ramana B.V, "Higher Engineering Mathematics", Tata Mc-Graw Hill Education, New Delhi, 2017.
2. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2017.
3. J K Goyal, K.P.Gupta, Laplace and Fourier Transforms, Pragati Prakashan, 2016

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH10E	**FUNDAMENTALS OF LASER TECHNOLOGY**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:

CO1: explain the fundamentals of lasers (CDL1)

CO2: demonstrate the laser surface modification process (CDL1)

CO3: describe the laser machining processes (CDL1)

CO4: identify the laser measurement and testing process (CDL1)

CO5: organizethe advanced applications and safety measures of laser (CDL1)

CO1: explain the fundamentals of lasers

Characteristics of laser -laser principle- population inversion-line broadening mechanisms-Q switching - threshold condition for laser-three-level and four-level systems-conditions for continuous wave (CW) and pulsed laser action- pumping schemes-classification of lasers: Er:YAG - carbon dioxide lasers - argon laser - X-Ray lasers - fiber lasers - Raman lasers. **L:9**

CO2: demonstrate the laser surface modification process

Laser surface heat treatment: process parameters - advantages and disadvantages of laser surface treatment; laser surface melting - laser direct metal deposition: processing parameters - methods for applying the coating material- laser alloying and cladding - advantages and disadvantages -laser physical vapor deposition - laser shock peening: analysis - advantages and disadvantages **L:9**

CO3: describe the laser machining processes

Laser welding parameters: beam power, spot diameter and traverse speed; welding efficiency; mechanism of laser welding: conduction mode welding, keyhole welding; laser cutting – process characteristics-fusion cutting, sublimation cutting, photochemical ablation;laser drilling –single pulse drilling-percussion drilling, trepanning applications - laser marking - dot matrix marking, engraving, image micro machining -lasers for marking - application **L:9**

CO4: identify the laser measurement and testing process

Laser for measurement - distance -length-velocity-acceleration-current-voltage-atmospheric effect-laser application in spatial frequency filtering. **L:9**

Holography: basic principle - methods - Holographic interferometry and applications-holography for non – destructive testing – holographic components

CO5: organizethe advanced applications and safety measures of laser

Laser advanced application in defence-laser weapons- industry for material handling: ASRS and AGV- medicine -laser activated therapy - photodynamic therapy, laser angioplasty, lasers in surgery - photocoagulation, photodisruption and photoablation - laser scanning confocal microscopy - Laser safety - danger - safety limits for eye and skin - class four safety arrangements - electric hazards- chemical hazards - fume hazards - explosion hazards - safety guidelines **L:9**

TEXTBOOKS:

1. William M. Steen, “Laser Material Processing”, Springer Verlag, 2010
2. K.Thyagarajan, AjoyK.Ghatak, “Lasers, Theory and Applications”, Springer, 2nd Edition, 2011.
3. Chunlei Guo, Subhash Chandra SinghHandbook of Laser Technology and Applications Lasers Applications: Materials Processing and Spectroscopy, 2nd Edition, (Vol.3), 2021

REFERENCES:

1. Uday Shanker Dixit, Shrikrishna N. Joshi, J. Paulo Davim, “Application of Lasers in

Manufacturing" Springer Singapore, 1st Edition, 2019
2. Stephan Wieneke and Christoph Gerhard, "Lasers in Medical Diagnosis and Therapy Basics, applications and future prospects" IOP Publishing Ltd, 2018
3. AK Katiyar, CK Pandey and Manisha Bajpai, "Fundamentals of Laser Systems and Applications", Wiley, 2017.

L : 45; TOTAL : 45 PERIODS

Course Code		**L**	**T**	**P**	**E**	**C**
23SH11E	**NANOMATERIALS FOR ENGINEERS**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:

CO1: explain the fundamentals of nanomaterials (CDL1)

CO2: interpret the different properties of nanomaterials (CDL1)

CO3: demonstrate the synthesis of nanomaterials (CDL1)

CO4: illustrate the characterization of nanomaterials (CDL1)

CO5: organize the applications of nanomaterials(CDL1)

CO1: explain the fundamentals of nanomaterials

Introduction to nanomaterials - size effect - specific surface area - surface to volume ratio - quantum confinement effects - morphology - density - melting point - wettability - classification based on the dimension - nanoparticles - nanowires - nanoclusters - nanotubes - quantum wells - metal based nanomaterials - nanocomposites - carbon nanotubes - nanosized metals - alloys - semiconductors - ceramics **L:9**

CO2: interpret the different properties of nanomaterials

Mechanical behavior- comparison of bulk and nano materials - elastic and plastic deformation - tensile strength - superplasticity -hardness - nano hardness -influence of porosity - grain size – thermodynamics of nanoparticles- heat capacity – phase transformation of nanoparticles- electrical and optical properties: electrical conductivity in nano tubes, nano rods and nanocomposites - photoconductivity of nanorods - electroluminiscesnce in nanoparticles- magnetic properties: magnetic hysteresis - superparamagnetism **L:9**

CO3: demonstrate the synthesis of nanomaterials

Bottom-up and top-down approach - inert gas condensation - plasma arc technique - ion sputtering - ball milling - molecular beam epitaxy - chemical vapour deposition - method - electrodeposition - ultrasonication - microemulsions method - solvothermal synthesis - microwave assisted synthesis. **L:9**

CO4: illustrate the characterization of nanomaterials

X-ray diffraction - energy dispersive spectrum - atomic force microscopy - high resolution transmission electron microscopy - Raman spectroscopy - x-ray photoelectron spectroscopy - electrochemcial characterization measurements - cyclic voltammetry - linear sweep voltametry - Brunauer-Emmett-Teller - surface area analysis - nanoindentation - determination of nano hardness. **L:9**

CO5: organize the applications of nanomaterials

Functional graphene - carbon nanotube - polymer composite applications in defence and aerospace - nanomaterials for solar cells - nanoscale catalysts for energy and automobile industries - rechargeable batteries based on nanomaterials - nanomaterials for electrodes and **L:9**

wearable electronics - nano based coating and paints - nanosensors -gas sensors - bio sensors - nano electro mechanical systems

TEXTBOOKS:

1. Charles P Poole, Frank J Ownes, Introduction to Nanoscience and Nanotechnology, An Indian Adaption, Wiley, 2020
2. Hornyak, G.Louis, Tibbals, H.F., Dutta, Joydeep, Fundamentals of Nanotechnology, CRC Press, 1st Edition, 2018
3. Dieter Vollath, Nanomaterials an introduction to synthesis, properties and applications, Wiley, 2nd Edition, 2013

REFERENCES:

1. Narendra Kumar, Sunita Kumbhat, Essentials in Nanoscience and Nanotechnology, Wiley, 1st Edition, 2016
2. G. Cao,Ying Wang, Nanostructures and nanomaterials: Synthesis, properties and applications, Imperial College Press, 2nd Edition, 2011
3. B.S. Murty , P. Shankar , Baldev Raj , B B Rath , James Murday, Textbook of Nanoscience and Nanotechnology, Springer, 1st Edition, 2013

L : 45; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH12E	**PHOTONICS**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:
CO1: explain the basics of photonics (CDL1)
CO2: demonstrate the properties of photonic crystal (CDL1)
CO3: outline the basics of bio photonics (CDL1)
CO4: interpret the quantum confinement in photonic materials(CDL1)
CO5: organize the applications of photonic materials (CDL1)

CO1:explain the basics of photonics

Wave phenomena – interference, diffraction-photon properties - energy, flux, statistics-Interaction of photons with atoms-optical amplification-three and four level system -EDFA-semiconductor light sources-detectors-light manipulation - birefringence - Faraday's rotation - interaction of light with RF and acoustic waves - Raman-Nath diffraction experiment . **L:9**

CO2: demonstrate the properties of photonic crystal

Electromagnetic theory of light-electromagnetic properties of material- polarization of light; Reflection and refraction- Fresnel equations; absorption, dispersion, and scattering of electromagnetic waves -Bragg grating; 1D photonic crystals -photonic band structure-real and reciprocal lattices; 2D and 3D photonic crystals-emerging applications of photonic crystals - 1D Bragg grating - periodic dielectric wave guide - 2D photonic crystal slab and fibre. **L:9**

CO3:outline the basics of bio photonics

Fundamentals of light and matter-basics of light-matter interactions in molecules, cells and tissues -lasers for biophotonics -bioimaging: principles and applications-transmission microscopy, Kohler illumination-optical biosensors-light activated therapy: photo thermal and photo dynamic therapy- tissue engineering with light- optical tweezers, scissors and traps - bio nanophotonics applications - bio chip - DNA micro-arrays - gene chip - lab on chip. **L:9**

CO4:interpret the quantum confinement in photonic materials

Quantum confined materials: quantum wells, quantum wires, quantum dots, quantum rings, manifestations of quantum confinement, optical properties, quantum confined stark effect, dielectric confinement effect. **L:9**

Nanoplasmonics: optical response of metals, plasmons, optical properties of metal nanoparticles, size dependent absorption and scattering, coupled nanoparticles - metal-dielectric core-shell nanoparticles - local electromagnetic fields in metal nanoparticles.

CO5: organize the applications of photonic materials

Excitation energy transfer – device operation: nanophotonic AND gate - nanophotonic OR gate – interconnection with photonic devices - metamaterials concept; super lens, hyperbolic metamaterials and application in high-resolution imaging: hyper lens - tunable photonic metamaterials based devices - electro-optical metamaterials - phase-change metamaterials - metamaterials in solar energy harvesting - perfect absorbers and thermal emitter **L:9**

TEXTBOOKS:

1. Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, 3rdEdition, Wiley,2019.
2. Brian Culshaw, Introducing Photonics, Cambridge University Press, 2020.
3. Gerd Keiser, Biophotonics: Concepts to Applications, second edition, Springer Nature Singapore Pvt. Ltd 2022.

REFERENCES:

1. Joseph W. Haus, Fundamentals and Applications of Nanophotonics, Woodhead Publishing, 2016.
2. W.Cai and V. Shalaev, Optical Metamaterials: Fundamentals and Applications, 2ndEdition, Springer, 2024.
3. P PYupapin, K Srinuanjan, S Kamoldilok, Devices, Circuits and Systems: Nanophotonics, Pan Stanford Publishing, 2013.
4. Paulo Ribeiro, Maria Raposo, "Optics, Photonics and Laser Technology", Springer International publishing, 1stEdition, 2018

L : 45; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH13E	**BIOLOGY FOR COMPUTING**	3	0	0	0	3

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to

CO1: describe the structure, interaction and applications of biomolecules
CO2: interpret the structure and functions of the gene and protein using the bioinformatics data
CO3: simulate the behavior of simple biological models using computational softwares
CO4: identify and design molecules for new drug development by computational methods

CO1: describe the structure, interaction and applications of biomolecules **L:9**

Biomolecules-I :

Introduction – monomeric units and polymeric structures of carbohydrates, proteins, nucleic acids and lipids. Enzymes: enzymatic action via Lock and key – Enzyme therapy - immune response monitoring – molecular modification – encapsulation. Agarose gel electrophoresis: SDS, PAGE and 2D – Molecular interactions: covalent and non-covalent interactions, antigen – antibody interactions. Methods to measure the interactions: UV-visible and single crystal X-ray diffraction.

Biomolecules -II **L:9**

Chromosome structure and function – chromosome abnormalities – chromosome dynamics – nuclear architecture. DNA transcription, replication and segregation. DNA finger printing. Pedigree analysis. Identifying human disease genes (functional cloning versus positional cloning; mutation screening). Human genome project: introduction – steps – salient features. Hap map project – salient features.

CO2: interpret the structure and functions of the gene and protein using the bioinformatics data **L:9**

Bioinformatics: introduction – biological databases – types. DNA databases – EMBL, gene bank, DDBJ. Protein databases: Swiss Prot/TrEMBL, PIR. Sequence motif databases - Pfam, PROSITE, Protein structure databases, protein data Bank – SCOP, CATH, and KEGG. Sequence analysis – methods of sequencing: sangar method, maxama - gilbert method and edman degradation method, NGS methods of sequencing.Basic local alignment search tool (BLAST) – types – determining the identity of an organism from its r DNA gene nucleotide sequence. Softwares for handling the databases – ChemDiff.

CO3: simulate the behavior of simple biological models using computational softwares **L:9**

Quantum mechanics: influence of physics on theoretical chemistry. Semi empirical methods – slater determinants – Hartree – Fock equation. Semi empirical models - Ab-initio calculations: Thermodynamic functions – koopmans's theorem – isodesmic reactions, Density functional theory for larger molecules. Introduction to Gaussian and ADF : Geometry optimization, frequency calculation, location of transition state, intrinsic reaction co-ordinates, molecular orbitals and population analysis, natural bond orbital analysis, calculation of equilibrium constants and rate constants. Introduction to GROMACS: GROMACS input files, simulations of liquid water, water methanol mixtures, S-peptide and free energy of salvation. Introduction to SCILAB- Scilab programming: Curve fitting, integral transforms and introduction to molecular dynamics. Execution of programs for liquid argon.

CO4: identify and design molecules for new drug development by computational methods **L:9**

Drug design: General approach to discovery of new drugs – lead modification – calculation of the various drug likeness rules like Lipinski's rule, MDDR - like rule, Veber rule, Ghose filter, BBB rule, CMC-50 like rule and Quantitative estimate of drug-likeness (QED) using DruLiTo and Swiss ADMEsoftware. Pharmacokinetic properties of drug using Osiris and Molinspiration software. Structure-based drug designing approaches - target identification and validation - physiochemical principles of drug action – drug stereo chemistry – drug action - 3D database – computer aided drug design. Identification of the suitable target using Pharmmapper - Molecular docking programs using Autovina softwares and visualization tools - Preparation of protein and ligand using ADT and pymol-generation of paper publication-quality images and data analysis-protein-protein docking-Protein DNA docking

TEXT BOOKS

1. Shawn T. O'Neil, A Primer for Computational Biology, Oregon State Campus, Corvallis, USA, 2019.
2. Frank Jensen, Introduction to Computational Chemistry, 3rd Edition, Wiley publishing LLC. USA, 2016
3. Philly Charles, Genes, Genomes, Genetics and Chromosomes, Nottinghamshire, England, 2020.

REFERENCE BOOKS

1. Ariel Fernández Stigliano, Biomolecular Interfaces: Interactions, Functions and Drug Design, 1st Edition, Springer International Publishing AG, London, 2016.

2. S.C. Rastogi, P.Rastogi, N.Mendiratta, Bioinformatics: Methods and Applications - Genomics, Proteomics and Drug Discovery, 5th Edition, PHI Learning Pvt. Ltd., Delhi, 2022.
3. Robert A. Copeland, Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis, 3rd Edition, Wiley-Blackwell, New York, 2023.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23SH14E	**BIOLOGICAL SYSTEMS FOR ENGINEERS**	3	0	0	0	3

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to

CO1: understanding of bio design principles to create novel devices and structures and cell biology

CO2: explain the structure and stability of biomolecules

CO3: describe the principle, components and applications of various instruments for medical diagnosis

CO4: interpret the major bio-energetic pathways

CO5: explain the properties characterization and application of various biomaterials

CO1: understand the basic principles of biology to create novel devices **L:9**

Cell - prokaryotic and eukaryotic cells - plant cell and animal cell - structural and function of Mitochondria - Chloroplast - Lysosomes - Golgi bodies - Nucleus. Cell cycle: mitosis and meiosis. Bioinspired devices: GPS, aircrafts, swim suits, bullet train, super hydrophobic and self-cleaning surfaces.

CO2: explain the structure and stability of biomolecules **L:9**

Introduction - monomeric units and polymeric structures of carbohydrates, proteins, nucleic acids and lipids. Molecular interactions: covalent and non-covalent interactions – methods of quantification and determination: UV – visible, CD, and SPR.

Enzymes - classification - specific activity - enzyme activity - chemical nature of enzymes. Protein and non-protein nature of enzymes. Metalloenzymes and metal activated enzymes. Industrial applications of enzymes: biosensors and bio bleaching.

CO3: describe the principle and applications of various instruments for medical diagnosis **L:9**

Basic concepts of instrumentation: static and dynamic characteristics, design criteria, instrumentation, amplifiers. Biopotential electrodes: fundamentals - body surface electrodes - microelectrodes - Principle, components and applications of microscope: light and electron microscope. Electrocardiograph, glucometer, CT, magnetic resonance imaging, ultrasonic imaging. Artificial Intelligence for disease diagnosis.

CO4: interpret the major bio-energetic pathways **L:9**

Thermodynamics in biological systems - exothermic and endothermic versus endergonic and exergonic reactions - concept of K_{eq} and its relation to standard free energy - spontaneity - ATP as an energy currency. Glucose synthesis from CO_2 + H_2O (photosynthesis) – decomposition of glucose (Glycolysis and Krebs cycle). Energy yielding and energy consuming reactions. Concept of energy charge. Regulation of glycogenesis - measurement of blood glucose level.

CO5: explain the properties, characterization, and applications of various biomaterials. **L:9**

Biomaterials: introduction - types: alloys, polymers. Composites - properties: biocompatibility, elasticity, immune compatibility, resorbability, cytotoxicity, hemocompatibility and biodegradability. Physicochemical characterization: XRD and SEM. Applications: tissue engineering, heart valves, dental and orthopaedic implants.

TEXT BOOKS

1. Y.Nelson, L.David, Lehninger, "Principles of Biochemistry", International Edition. New York, 7th Edition, 2017.
2. Nagata, Kazuhiro, Real-Time Analysis of Biological Interactions, Springer, Japan, 3rd Edition, 2015.
3. I. Bertini, H.B Gray, Bioinorganic Chemistry, University Science Book, California, 4thEdition, 2014.

REFERENCE BOOKS:

1. P.N.Bartlett, Bioelectrochemistry: Fundamentals, Experimental Techniques and Applications, 2nd Edition, John Wiley & Sons, New Delhi, 2014.
2. Ratner and Hoffmann, Biomaterial Science: An Introduction to Materials in Medicine, 2nd Edition, Elsevier Academic Press, London, 2015.
3. Lesile Cromwell, "Bio-medical instrumentation and measurement", Prentice Hall of India, New Delhi, 2nd Edition, Reprint, 2017.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23SH15E	POLYMER SCIENCE AND TECHNOLOGY	3	0	0	0	3

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: acquire knowledge on structure - property relationship of polymers

CO2: identify the suitable polymerization techniques for the large scale synthesis of polymers

CO3: explain the basic principles of various polymer processing techniques and their applications

CO4: interpret the chemical, thermal, electrical, and mechanical properties of the polymers

CO5: familiar with plastics waste disposal, value addition, associated environmental issues and legislation

CO1: acquire knowledge on structure - property relationship of polymers **L: 9**

Basic concepts of polymerization - polydispersity - conformation and configuration of macromolecules - stereo isomerism and tacticity in polymers - geometrical isomerism. Structure - property relationship -molecular force and chemical bonding in polymers - effect of polymerization on PDI. General rules for polymer solubility - crystallinity and orientation in polymers. Polymer chain flexibility: concept - factors deciding polymer flexibility - amorphous and crystalline polymers - crystallinity in polymers - factors affecting crystallinity - properties affected by crystallinity of polymers. Glass transition temperature and crystalline melting points. Factors affecting glass transition temperature.

CO2: identify the suitable polymerization techniques for the large scale synthesis of polymers **L:9**

Basic aspects of polymer synthesis - bulk, solution and suspension polymerization (styrene

and MMA) - emulsion polymerization (vinyl acetate, styrene) - preparation of phenolic and epoxy resins. Modern techniques in polymerization: metathesis polymerization - controlled polymerization methods, viz., nitroxide mediated polymerization (NMD), atom transfer radical polymerization (ATRP), group transfer polymerization (GTP), and reversible addition fragmentation termination (RAFT).

CO3: explain the basic principles of various polymer processing techniques and their applications **L:9**

Plastics technology: raw materials - additives for compounding (fillers, plasticizers and softeners, lubricants, promoters, anti-aging additives, flame retarders, colorants, blowing agents, UV stabilizers,) - requirements and functions of additives. Pre-compounding operations: mixing, drum blenders, ribbon blenders, mixing rolls, internal mixers, mixing extruders, blenders for making organosol and plastisol, granulators, pelletizers.

Advanced fabrication techniques: RTM, RIM, filament winding, BMC/SMC. Post-forming and finishing, machining, welding and design of polymers products. Selections of polymers, additives, mold design. Analysis of defects in moulded products. Processing of reinforced thermoplastics and thermosets: manual processing methods and semi-automatic processing methods. Rubber processing: internal mixer and open mill.

CO4: interpret the chemical, thermal, electrical, and mechanical properties of polymers **L:9**

Physical testing: density, mechanical behaviour, MFI, and water/solvent adsorption. Chemical testing: ignition - pyrolysis - solvent extraction - elemental analysis. Thermal analysis: vicat softening point - dynamic mechanical thermal analysis. Morphological analysis: atomic force microscopy and chemical force microscopy. Spectroscopic analysis: IR peaks assigned for rubber. Study of hydrogenation, halogention, evidence for cyclization and formation of ionomers. Analysis of carbon filled rubber - Case studies.

CO5: familiar with plastics waste disposal, value addition, associated environmental issues and legislation **L-9**

Polymer waste: sources, collection, segregation, and identification by simple techniques. Life cycle assessment, risk factor analysis. Plastics waste management techniques: chemical recycling, thermal conversion technologies, microbial, microwave, and ultrasonic. Use of plastics waste for value addition. Plastics waste management rule - environmental issues.

TEXT BOOKS

1. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, 3rd Edition, McGraw Hill Education, 2017.
2. Richard A Petherick, Polymer Science and Technology for Engineers and Scientists, Whittles Publishing, 2010.
3. Michael L. Berins, SPI Plastics Engineering Handbook of the Society of the Plastics Industry, Inc. 1st Edition, Springer New York, 2012
4. Vishu Shah, Handbook of Plastics Testing Technology,2nd Revised edition, Wiley–Blackwell, 1998**.**

REFERENCES

1. Gowarikar V R, Polymer science, 5th Edition, New Age International Private Limited, 2023
2. Fred W. Billmeyer, Textbook of Polymer Science, 3rd Edition, John Wiley & Sons, 2007
3. Nayak S.K, Text Book on Fundamentals of Plastics Testing, Springer (I) Private Limited, 2020
4. J S Anand, Recycling & Plastics Waste Management, Central Institute of Plastics Engineering

and Technology, 1997.
5. Korschwitz J, Polymer Characterization and Analysis, John Wiley and Sons, 1990.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23SH16E	**SENSORS FOR ENGINEERING APPLICATIONS**	3	0	0	0	3

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Gain knowledge on basic concepts of sensors and Transducer.

CO2: know about the thermal and motion sensors for various applications.

CO3: enumerate the principles and applications of optical and magnetic sensors and transducers used in various field.

CO4: explain the construction, working principle and applications of electrochemical and electric sensors.

CO5: Design the sensors for environmental monitoring

CO1: Gain knowledge on basic concepts of sensors and Transducer. **L: 9**

Introduction – Historical development of sensors – Human body as a sensor system – sensors and transducers. Principle and classification of sensor. Sensor characteristics – sensor properties – various transducers – piezoelectric effect – pyroelectric effect – seebeck effect and peltier effect. Advantages and limitations of Sensors.

CO2: know about the thermal and motion sensors for various applications. **L:9**

Thermal sensors: introduction – types - primary sensor: gas thermometer and He low temperature thermometer. Secondary sensor: Resistance thermometer and NQR thermometer. Temperature sensing technologies: IC sensor, resistive temperature detectors, thermocouples and thermistor.

Motion sensors: Introduction and principle. Types: Infra red and microwave. Specialized motion sensor: proximity and ranging sensor. Motion Sensors in everyday life: The role of motion sensors in home security.

CO3: enumerate the principles and applications of optical and magnetic sensors and transducers used in various field **L:9**

Magnetic sensors: Introduction – principle and applications: magnetic field sensors and magneto-resistive Sensors, hall effect sensors.

Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor, CCD, CMOS sensors. Pulse oximeter, portable pulse oximeter, wearable pulse oximeter; wearable capnometer for monitoring of expired.

CO4: explain the construction, working principle and applications of electrochemical and electric sensors **L-9**

Electrochemical sensors: Introduction - fundamental concepts – chemiresistors. Conductometric sensor: amperometric sensor - potentiometric sensors - impendence sensors.

Electric sensors: Introduction- conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. Real time applications: Glucose Monitoring

Devices, GlucoWatch G2 Biographer, GlucoTrackTM; Pulse oximeter, Portable Pulse Oximeter, wearable pulse oximeter.

CO5: Design the sensors for environmental monitoring **L-9**

Environmental Sensor: Introduction - environmental quantities**:** time, moisture acidity/alkalinity, wind-chill, radioactive count rate. Surveying and security. Sensors for environmental monitoring. Smoke and fire detector. Pressure sensor in emission testing, pollution devices, and wind management systems.

TEXT BOOKS

1. Jacob Fraden, Handbook of Modern Sensors: Physics, Design and Applications, 5th edition, Springer Nature, New Delhi, 2016
2. D. Patranabis, Sensors and Transducers, 2nd Edition, PHI Learning Private Limited, New Delhi, 2013.
3. John Veteline, Aravind Raghu, Introduction to sensors, CRC press, New Delhi,2011.
4. S Nihtianov, A. Luque Smart Sensors and MEMS, 2nd Edition, Woodhead Publishing Limited, New Delhi,2018.
5. Edward Sazonov and Michael R. Neuman, Wearable Sensors - Fundamentals, Implementation and Applications, Elsevier publishing company, Amsterdam, Netherland,2014.

REFERENCE BOOKS

1. Shantanu Bhattacharya,A K Agarwal, NripenChanda, Ashok Pandey and Ashis Kumar Sen Environmental, Chemical and Medical Sensors, Springer Verlag, Singapore,2018 .
2. Krzysztof Iniewski, Optical, Acoustic, Magnetic, and Mechanical Sensor Technologies, 1st Edition, CRC Press, New Delhi, 2017.

L: 45; TOTAL: 45 PERIODS